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Magnitude of the Electrical Utilities

Much valuable information concerning the magnitude of the central-station industry in the United States and its growth during the past decade is presented elsewhere in this issue. Exclusive of $36,500,000 obtained from the sale of energy for railways, the central stations of the country obtained a total income of $302,000,000 from energy utilized in lighting, heating and industrial service during 1912, an increase of 250 per cent over the income during 1902. The chief items contributing to the enormous growth of the electrical energy supply business in the decade indicated are outlined on page 586 and will be discussed more fully in a later issue.

Resuming Our Onward March

It will perhaps be remembered that the value of electrical exports in November, 1913, showed a decline as compared with the same month in 1912, it being the first time in a long period that anything of the kind had happened. The expansion and development of such foreign trade had been persistently steady, and the incidental retrogression came with a shock that would have been more intensely felt had it not been realized that conditions generally were so bad it was hardly reasonable to expect an exception in any quarter subject to normal and international influences. It was, in fact, a period of low ebb in industrial and financial activity, of depression in banking circles and of anxiety among business men as to what might be coming along to hit them next. The scene changed certainly and suddenly about that time, with brighter hues and more cheerful outlook, and while business is still none too good it is going the right way. The electrical exports of December, 1913, are a slight indication in their way of the general trend, for it may be noted that they resume the interrupted onward march. They amounted to $2,233,-999 as compared with $2,186,264. The gain over the corresponding month was slight, but it was a gain. There has been practically a universal feeling that 1913 was an off year and that better times could not arrive until the date changed. But, on the whole, electrical exports were good, and the total figures for the year maintained the increase of 1912 over 1911. The figures are, for 1911, $19,355,536; for 1912, $23,212,813, and for 1913, $28,197,363. Here is an advance full of real encouragement, for it will be conceded that trade in 1913, especially toward the end of the year, had few cheering aspects. How much better, then, we ought to do in 1914, with peace restored in Europe, the tariff settled and currency problems worked out to a satisfactory finish!

Saving Commissions on Utility Issues

Of more than passing interest is the offer by the Third Avenue Railway, New York, of $4,000,000 of 4 per cent bonds directly to private investors. One reason for this move is stated to be the popular aversion to banking commissions paid in connection with public utility financing. The plan is not new but is sufficiently rare to be worth consideration in connection with the sale of securities under average conditions of utility credit and the capacity of local investment markets to absorb public service corporation issues. If local investors will buy the securities of their public service corporations directly, so much the better. No company that can sell stocks or bonds in this way will object to saving bankers' commission or discount from par, or to giving at least a part of these bankers' profits to customers and the general public. It would be foolish to suppose that under all circumstances the assistance of bankers could be dispensed with in marketing securities There is, on the other hand, no reason why, under favorable circumstances as to corporate credit and the security market, a utility should not cut out the banker middleman and sell its securities over its own counter. Instead of assuming that recourse must be had to the bankers in every case, it may be well to consider whether or not a direct sale of securities could not be made. A few successful experiments along this line might do much to change for the better existing customs in utility financing.

Teaching the Public About Utilities

Aside from the interest which attaches to the subject matter of the lectures themselves, the public utility lecture course recently inaugurated by the Finance Forum of the Y. M. C. A. in New York, referred to in this issue, has considerable significance as a sign of the times. A strictly practical organization like the Y. M. C. A., the principal object of whose existence is to secure and hold the attention, sympathy and interest of young men and to offer them some clean and profitable way of spending their leisure time for the good of their minds, bodies and morals, may be assumed to know something of the ways and means best calculated to achieve these results. The Finance Forum selected the subject of public utilities for the lecture course simply for the reason that the young men wanted to learn something about utilities. Since these young men are drawn indiscriminately from the public and may fairly be taken as types of the educated American, it would seem that the general public in 1914 is beginning to realize the desirability of understanding a little more

of the technique and economics of public service. The electrical interests should be truly grateful that the public is exhibiting this tendency. The regulation of utilities by commissions is no longer a theory but an accomplished fact, the total effect of which on the electrical industry can safely be characterized as good, although in certain notorious instances its effect has been bad. A repetition of such instances can be avoided only by breaking down prejudice and ignorance and by appointing regulating commissioners who are mentally capable of serving the public best by taking into consideration the interests of the utilities which they are to regulate. If this result cannot be secured, the next five years may be lean for the electrical industry and equally bad for the public. For the welfare of the whole country it is to be hoped that the public will be instructed diligently concerning some of the fundamentals of our mighty, but sensitive, public service utilities, and will learn to select the right men for the regulating commissions.

Transmission-Line Problems

Among the papers presented at the recent convention of the American Institute of Electrical Engineers was one by Mr. P. W. Sothman on the problems of high-tension transmission lines. This is mainly directed to structural elements of the modern tower line, and it contains many useful suggestions based on experience. Tower-line construction is ordinarily accompanied by suspension insulators, and these give a certain mechanical flexibility to the suspended conductors, very different from the tight grip of the pin insulators. In some respects this flexibility is an advantage. In other respects it is a source of danger, and special precautions have to be taken to limit the flexibility.

One of the electrical subjects discussed is the benefit obtainable from an over-all ground wire as a lightning protector. It is pointed out that the consensus of experience is in favor of such benefit being secured. It is interesting to note, however, how much difference of opinion exists among engineers and central-station managers as to the degree of protection which over-all ground wires can secure. It seems likely that this difference of opinion is largely due to the variability of lightning. An overhead line is run across country and suffers accidents from lightning. In order to reduce the damage, an over-all ground wire is installed. A comparison is then attempted to be made between the lightning troubles encountered before and after the addition. If the lightning disturbances were systematic, regular and occurred on schedule time, this procedure would naturally be reliable; but, the opposite qualities being notorious in lightning disturbances, judgment is apt to be baffled and accurate comparison rendered futile.

There seems to be a general agreement that modern high-tension lines, operating at, say, 60 kv and over, are less subject to lightning disturbances than lower-tension lines used to be. We may well suppose that this result is attributable to the better and more thoroughly insured insulation obtained with the modern disk insulator string. It may be fair to say that the well-constructed tower line of the future will be practically free from induced disturbances due to lightning strokes in the vicinity. Occasionally, however, lightning strokes from cloud to ground may be expected to connect directly with the line, or include the conductors in its path, even in spite of the shelter of over-all ground wires. In such cases the discharges are apt to be so powerful that break-downs must occur. In other words, we can expect improvements in aerial line construction and insulation to be proof only against indirect strokes. We can hardly aspire to making them proof against direct strokes. Fortunately the direct strokes are only a small percentage of the indirect strokes.

The Justifiable Holding Company

Some of the last testimony before a committee of Congress on trust legislation has borne directly upon the holding company for electric utilities. Mr. Flexner, representing the Middle West Utilities Company, an abstract of whose testimony is given in this issue, spoke on this point. It is well that the views of Congress should be clear on the subject. The holding company cannot be legislated out of existence without destruction to existing legitimate industry. It is true that the holding company for public utilities represents an aggregation of plants. But in the collection of these plants the object is not to effect a monopoly of the kind against which public opinion is aroused. It is to bring together under a single executive and financial management plants that are usually widely separated in territory and without the chance for competition. To this aggregation of plants economies in financing and operation are applied. The monopoly in such companies is the monopoly rendered usually by a single utility company in each community. That is the sort of monopoly which economists favor. It is the kind which commissions promote in practice and commend in theory. They not only promote such monopoly but they discourage competition against such monopoly. The reason why they do so is plain and justifiable. Competition in such cases means duplication of plant. The logical end of such duplication is consolidation. That means that the public is called upon to pay rates providing a return on both plants. To prevent this duplication of facilities and investment, to prevent two like plants from growing where one grew before, is the practice of the commissions. Investigation by Congress will prove the economic soundness of these principles. The holding company in public utilities is merely a device for bringing these monopolies together. It is true that evils develop in such companies, but they do not arise from the inherent monopolistic character of the operating underlying companies. They arise from other conditions which are just as likely to develop in small individual companies as in groups of these companies.

Direct-Current 2400-Volt Railway

The account of the electrification work of the Butte, Anaconda & Pacific Railway elsewhere in our columns is of particular interest as dealing with the first case in which a railroad has substituted for its steam-locomotive system a high-voltage direct-current system of considerable magnitude. The total trackage of the section equipped, including sidings and yards, rises to the respectable figure of 95 miles, although the road is not a long one. It is chiefly devoted to hauling copper ore from the mines at Butte to the smelters at Anaconda, only four passenger trains being operated daily in each direction. The total freight traffic amounts to something like 5,000,000 tons a year, handled in trains weighing from 1400 tons to 4000 tons according to the section of the system on which they are operated. For freight-train operation two articulated double-truck locomotives are coupled together while for switching and passenger service a single unit suffices. The locomotives weigh about 80 tons each and can give about 1000 hp continuous output.

The system, which has been in operation as a whole for about six months, has given a good account of itself. Energy for its operation is derived from the Great Falls plant over a line 130 miles long worked at 102,000 volts. A pair of 1000-kw motor generators are installed in each of the substations at Butte and Anaconda respectively, the 26-mile railway line being practically fed with energy from each end. In the motor-generator sets a single synchronous motor drives a pair of 500-kw, 1200-volt generators connected in series. The motors on the locomotives are insulated for 2400 volts but wound for only 1200 volts, two being connected permanently in series. Altogether the system is a very interesting application of high-voltage direct current in locomotive units of considerable output doing a large amount of regular heavy work. Their operation will be watched very keenly as affording much information concerning the desirability of applying the same solution to much larger problems.

The Half-Watt-per-Candle Lamp

The recent development of an incandescent lamp consuming only about half a watt per mean horizontal candle, with a correspondingly high working temperature, has brought renewed interest to studies of high-temperature radiation. Some investigations in this direction have recently been published in the *Zeitschrift für Beleuctungswesen Heizungs und Lüftungstechnik*, as mentioned in our Digest. Two types of the new lamp are discussed and reported upon. The working temperature of the filament is computed from observations of the spectrum and of the specific consumption. The results indicate that the working temperature is very nearly in direct proportion to the watts consumption, and that it reached about 2850 deg. absolute in one of the lamps tested. In the new lamps the working temperature is carried to a new stage of elevation, above which it seems at present undesirable to carry the incandescing filament. Nevertheless, the ratio of the luminous to total emitted radiation is still so low that there is great room for further improvement. Whether the improvement can be expected from recourse to yet higher temperatures is an open question. No improvement in incandescent-lamp efficiency has yet been made without a rise in working temperature, but in lamps employing luminous vapor, such as the mercury-vapor lamp, no such direct dependence on temperature has been found necessary.

Constant-Current Transmission

The account by Dr. Louis Bell in this issue of the practical working of the Thury plant between St. Maurice and Lausanne, Switzerland, furnishes evidence enough that the high-voltage direct-current transmission system is far from being a failure. This particular plant has been in operation for more than ten years, and although the apparatus would be very much simplified were the plant being built at the present time, it has made a good record throughout its long period of operation in a way that speaks volumes for the character of the construction. From the viewpoint of cost, the greatest fundamental difference between such a system and the ordinary alternating-current plant is the total absence in the former of the enormously expensive and forbidding switchboard apparatus to which the engineer is driven, or thinks he is driven, in the latter. The direct-current generating system is obviously considerably more expensive than an equivalent equipment in ordinary three-phase generators, but when one considers the cost of the transformers and of the switchboard control the case takes on a somewhat different aspect, still further modified when one includes the cost of the structure required to contain the accessories.

A very striking difference between constant-current and constant-potential operating is the facility with which the former may be worked with the ground as the return conductor. There seems to be no trouble at all in running these unidirectional constant-current systems with ground return whenever necessary in an emergency, or as a regular practice. It is found that a properly made ground circuit has less resistance than the transmission line itself so that there is a positive gain in efficiency as well as in convenience. A ground return with limited current is different from a ground return on a constant-potential system, and it certainly is a matter of no small importance to have a transmission circuit either wire of which when grounded can carry the full load indefinitely and without loss of efficiency. We believe that the uniform experience with these constant-current plants has been very gratifying from the standpoint of operation. While for ordinary cases nobody claims that they are equivalent to the three-phase plant in convenience and cheapness of distribution, they have certainly made a good record and have some unique advantages in operative qualities.

The News of the Week

**Activities and Events in the Electrical Field—
Reports of Meetings—Commission Findings, Etc.**

Long Acre Suit Dismissed

Supreme Court Justice Greenbaum threw out of court on March 6 the foreclosure suit of the Metropolitan Trust Company against the Long Acre Electric Light & Power Company, of New York City. It was brought by the trust company as trustee of the bond issue made by the Long Acre company in 1906 for $500,000, and it was alleged that the latter had defaulted in an interest payment of $96,000. Justice Greenbaum said that the Long Acre company had always been solvent and characterized the action as a scheme of the New York Edison Company to injure its rival.

Bill to Abolish Limited-Area Franchises

House bill No. 285, recently introduced in the Kentucky State Legislature, seeks to prohibit the granting of any franchise for a limited area covering the supply of gas, water or electricity. The bill is understood to be aimed at "block plants" operated in Louisville, Ky., Mayor Buschemeyer of that city having declared in this connection:

"The company which must supply service to everybody is forced to a certain extent to meet the competition of the block plant in the block where the latter operates. The cost of this competition is borne by patrons who do not live in territory supplied by block plants, because it postpones indefinitely the time when, by economical regulation and operation, rates all over the city can be reduced. It takes from the many to enrich the few, which makes the matter one of special privilege. To no company or individual should a franchise be given to use the public streets and alleys unless the service is to be furnished over the entire city."

Status of Water-Power Legislation in New York

In his message to the Legislature on March 5 on conservation of the resources of the State of New York Governor Glynn indorsed the hydroelectric bills prepared by the State Conservation Commission and now pending in the Legislature, providing for state development of water-powers. The Governor asserted that the 1,000,000 electric hp now being generated by the waters of the State has been handed over to private corporations without provision for adequate compensation to the State. He called for State development of the remaining, as he estimated, 1,500,000 hp of undeveloped water-powers and said that this would mean a saving in fuel bills of $50,000,000 a year.

A bill providing broadly for the development of New York State's water-powers by means of reservoirs and dams constructed by the State, with the operating rights leased to private corporations, was introduced in the Assembly on March 6 by Assemblyman Jones, of Watertown. The bill adds a new article to the conservation law ostensibly to control the flow of rivers. It provides for the establishment of river regulation districts along watersheds, and that any integral part of such a watershed may be made such a district on the application of three taxpayers to the Conservation Commission. The "river regulation districts" are made public corporations with perpetual powers. When a district is formed the Governor must appoint a board of three members with powers of eminent domain and to condemn property, except what belongs to a city. The State under the bill would hold title to all property so taken.

Industrial Disease a Personal Injury Under Compensation Act

The Supreme Court of Massachusetts has handed down a decision in the case of Hurle vs. American Mutual Liability Insurance Company to the effect that disease caused by industrial conditions may be treated as a personal injury under the Massachusetts workingmen's compensation act. In the case at bar the plaintiff, an employee in the power house of the Plymouth (Mass.) Cordage Company, became totally incapacitated for work by optic neuritis induced by poisonous gases inhaled about seventy times a day at the peepholes of a gas-producer installation. The court holds that a broad interpretation of the workingmen's compensation act justifies the Industrial Accident Board's finding in favor of the victim, and that while the preponderance in recent years of actions grounded upon some physical violence has tended to emphasize the aspect of injury which depends upon visual contact or direct lesion, this is by no means the exclusive meaning of the term "injury," and that it would not be accurate but lax to treat the act as if it referred merely to accidents.

Concrete Poles Withstand the Storm

The strength of the reinforced-concrete telegraph pole has been demonstrated upon more than one occasion during violent storms to which poles of the wooden type readily succumb. One of the most severe tests ever inflicted upon them occurred during the recent blizzard in the North Atlantic States, from which they emerged intact. Perhaps the most striking example of their extreme durability as exemplified in this storm was in the case of the telegraph line of the Pennsylvania Railroad Company, where a large number of reinforced-concrete telegraph poles were exposed to the storm which swept over the Hackensack meadows in the vicinity of the west entrance of the Pennsylvania tunnels leading into New York City. The company had erected many of these poles in recognition of their durable and storm-proof properties. The storm center was in and about New York City. The wind reached a velocity of from 70 to 80 miles an hour, and the accumulation of snow and ice was so great that New York was practically isolated for a time, at least so far as above-ground telegraphic communication with Philadelphia was concerned. The company's telegraph line was out of commission for a long time and many of the wooden poles were broken down by the wind and their burden

of snow and ice. In no case, however, did a reinforced-concrete pole collapse. So severe was the stress that the wooden cross-arms upon some of these poles were broken, but the poles themselves remained intact.

Low-Head Water-Power Development

In a paper recently read before the Illinois Electric Railways Association Mr. C. W. Humphrey, Chicago, consulting engineer, described the hydroelectric development of the McKinley System on the Illinois River at Marseilles, Ill. Mr. Humphrey remarked that it is only a few years since attention began to be attracted to low-head hydroelectric developments. Now the tendency toward such development is quite marked, and old abandoned mill sites in large number are being considered for hydroelectric development. Up to the present time, however, very few low-head developments have been made primarily as auxiliaries to steam plants. The general belief has been that the hydroelectric plant should be large enough to generate the entire requirement, except, possibly, during a low-water period, when a steam auxiliary might make up the difference. But, according to Mr. Humphrey, the fact is beginning to be recognized now that many low-head developments can be constructed at a cost so low that electricity can be generated for less than the fuel costs of a steam plant, even when the quantity is sufficient to supply only a small portion of the owner's requirements. The writer pointed out that any low-head water-power plant, even of very moderate size, can produce energy very cheaply if the plant can be operated continuously at its maximum rating whenever water is available.

In concluding his paper Mr. Humphrey said that the government reports for 1912 showed that the amount of water-power developed in the United States was 4,016,127 hp, while the total of the possibilities of water-power development amounted to 51,398,000 hp, or about thirteen times the amount developed or under construction. In 1912 the State of Illinois had 51,211 hp developed out of a possible 345,000 hp. Practically all of the possible developments in the State of Illinois fall in the low-head class.

Winter Advice to Electric-Truck Users

To electric-truck users in New York City the New York Edison Company has just issued a timely set of suggestions intended to secure the best operation of battery-driven wagons through the heavy snow drifts which have recently encumbered the streets of the metropolis. The instructions are printed on a heavy card, the reverse side of which bears a list of the Edison company's substations at which emergency charging service may be obtained. For such charging no cash is necessary, the firm's name on the truck being taken as sufficient guarantee of payment. The following advice is reproduced from the card, and is entitled "Truck Don'ts for Winter":

"Don't try to accomplish as much in the snow as you have on clear asphalt.

"Don't start out in the morning until you are satisfied that your battery has been fully charged.

"Don't try to push a drift ahead of you. Leave it for the snow contractor.

"Don't sit still while the wheels go 'round in the slush. Have a box of sand and a kitchen coal shovel handy. Use sand liberally. It is cheaper than electricity.

"Don't throw your power on full. Work it up gradually, not forgetting the sand box.

"Don't forget an anti-skid device. An improvised one may be made by looping three or four turns of a rope around your tires.

"Don't forget that time may be gained by leaving your wagon at the corner and making side-street deliveries on foot.

"Don't let your truck stay out all night for want of a boost. The New York Edison Company has twenty-four emergency charging stations in New York where your firm's credit is good."

Institute of Radio Engineers

At the March 4 meeting of the Institute of Radio Engineers, New York City, President L. W. Austin read a paper on "The Effect of a Parallel Condenser in the Receiving Antenna," and Mr. Louis Cohen, of the Bureau of Standards, Washington, D. C., described in his paper "A Method for Determining Logarithmic Decrement."

In his paper Dr. Austin commented on the practice of using a variable condenser in parallel with inductance in the receiving antenna to receive longer waves as being convenient and doing away with the necessity of small inductance steps. It also reduces the total amount of inductance required, but is usually found to be less efficient than purely inductive tuning. Tables showing the effects of different values of parallel capacity for two sizes of artificial antenna were shown. As the capacity was increased and the inductance decreased the galvanometer deflection decreased. Replacing one-half the inductance by capacity decreased the deflection about one-third. Practically the same results were obtained with the real antenna.

Mr. Cohen discussed the Bjerknes formula, stating briefly that as commonly used its results may be incorrect. He pointed out the desirability of developing another method for use in checking. Mr. Cohen proposed that, instead of detuning the wave-meter circuit until $LI^2 \div 2$ is obtained as in the common method based on the Bjerknes formula, the resistance of the wave-meter circuit be increased until $LI^2 \div 2$ is obtained; then with the inductance, frequency, resistance and added resistance of the wave meter known the desired decrement can be readily obtained.

Forthcoming Meetings of the A. I. E. E.

At Pittsburgh, Pa., April 9 and 10, the American Institute of Electrical Engineers will hold a meeting under the auspices of its committee on the use of electricity in mines, when the following papers will be presented: "Mine-Duty Controllers," by Mr. H. C. Reed; "Self-Contained Portable Electric Lamps," by Mr. S. W. Swoboda; "Mine Substations," Part I, "The Construction and Operation of Mine Substations," by Mr. H. Booker; Part II, "Motor-Generator Sets Versus Synchronous Converters as Applied to Mine Work," by Mr. W. M. Hoen, and "The Development of the Electric Mine Locomotive," by Mr. G. M. Eaton. There will also be a general discussion on rules for electrical installations in mines.

At Washington, D. C., April 24 and 25, there will be a joint meeting of the A. I. E. E. and the American Physical Society under the auspices of the Institute's electrophysics committee and its Washington Section. Five papers will be presented on behalf of the A. I. E. E., as follows: "A Theory of Corona," by Mr.

Bergen Davis; "Some Investigations of Lightning Protection for Buildings," by Mr. T. M. De Blois; "A Milliampere Current Transformer," by Mr. Edward Bennett; "Some Simple Examples of Transmission-Line Surges," by Mr. W. S. Franklin, and "Solenoids," by Mr. C. R. Underhill.

The annual business meeting of the Institute will be held at New York May 19. Following the business session there will be a technical program under the auspices of the committee upon electricity in marine work.

Another meeting of the A. I. E. E. will be held at Pittsfield, Mass., May 29, with headquarters at the Maplewood Hotel. The principal subject before this conference will be "The Relative Advantages of 'Y' and Delta Connections," and all of the papers presented will have some bearing on this general topic. The following papers have been promised for this meeting: "Grounding of Transmission Lines," Dr. C. P. Steinmetz; "Experience with Line Transformers," Mr. D. W. Roper; "A Study of Some Three-Phase Systems," Mr. C. L. Fortescue; "Relative Merits of 'Y' and Delta Connections for Generators," Mr. T. S. Eden; "Conditions Under Which Harmonics Are Produced," Mr. Clinker, and "Stresses in Three-Phase Operation," Mr. L. F. Blume.

The thirty-first annual convention of the American Institute of Electrical Engineers will be held in Detroit, Mich., June 22 to 26, 1914. Convention headquarters will be at the Hotel Cadillac.

Magnitude of Public Utilities

The first of a series of ten lectures on public utility questions arranged by the Finance Forum of the Young Men's Christian Association in New York, with the aid of the leading public utility interests of that city, was given at the West Side Branch of that organization on the evening of March 9. Mr. Henry L. Doherty opened the meeting by indicating the scope of the lectures and their significance at the present time. He said that in the strict interpretation of the term public utilities are included only electric lighting and motor service, gas and street railway enterprises, and that the series of lectures will aim to cover both the financial and the economic sides of the field. The bigness of public utility matters was brought out forcibly by a few figures on the growth of the urban population in this country and of the public utilities themselves. Mr. Doherty showed how the per capita use of their service increases with the increase in population of the cities.

Mr. T. Commerford Martin, executive secretary of the National Electric Light Association, was introduced as the speaker of the evening, on the subject "Magnitude of the Electric Light, Power and Transportation Business." Mr. Martin's many years of activity in connection with the government electrical census work enabled him to present, in concrete statistics, evidence of the remarkable growth of public utilities in this country during the past forty years. In 1877, according to Mr. Martin, the total investment in the electrical industry in this country amounted to about $50,000,000, practically all of which was in the telegraph, which was the only real commercial application of electricity at that time. To-day, Mr. Martin stated, the capitalization and investment—which he believes to be synonymous—in the various branches of the electrical industry are approximately $10,000,000,000, with an earning power of $2,000,000,000 a year. The growth was shown to have been a steady one, regardless of the financial crises in other lines of industry, at various periods since the above date, the average rate of growth for the past twenty years in the electrical industry having been 25 per cent per annum.

The manufacturing branch of the industry, on which all the other branches are dependent and which was at first the most important one, has now yielded first place to the operating branches, in which the largest amounts of capital are invested at the present time. The traction systems throughout the country have contributed largely to the development of its trade, and the energy-distributing systems have helped toward the establishment of many industries which could not have been carried on in any other way. All of the aluminum and nearly all of the copper produced in this country are refined or abstracted electrolytically. The large water-power resources of the South have furnished energy for the operation of cotton mills, which have come to the position of formidable competitors of the New England textile industry. Practically no progress is being made in the telegraph business at the present time, according to Mr. Martin, owing to the tremendous growth of the telephone systems throughout the country.

Cleveland Electrical Exposition

Cleveland, Ohio, is planning to hold an electrical exposition at the Coliseum May 20 to 30, under the auspices of the Electric League of Cleveland. This is to be the first exposition of its kind ever held in that city, but owing to the abundance of electrical industries in the vicinity it is anticipated that as much importance will be attached to the event as was given to the industrial exposition held a short time ago. The main purposes of the electrical exposition are: To educate the community as to the advantages of electricity for illumination, industrial power and household use; to display time and labor-saving devices operated by electricity; to encourage people to use more electrical appliances and to foster a general interest in the electrical industries of Cleveland and vicinity. Electrical processes as well as products will be shown. An elaborate decorating and lighting scheme will be employed in order to make the Coliseum attractive by both night and day.

An executive committee of fifteen and an exposition committee of 150 will have charge of affairs, with Mr. William G. Rose acting as manager. A publicity campaign will scatter broadcast facts and figures concerning the event to arouse interest. The executive offices are located in the Illuminating Building, Public Square, Cleveland.

Annual Dinner of Engineers at Boston

The fifth annual dinner of the Boston Section of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the Boston Society of Civil Engineers was held at the Boston City Club on March 4, nearly 250 being present. The speakers were Mr. Guy E. Tripp, chairman of the board of directors Westinghouse Electric & Manufacturing Company; President C. O. Mailloux of the A. I. E. E., President James Hartness of the A. S. M. E., Dr. A. E. Kennelly of Harvard University, and Dr. Milton W. Franklin, Sprague Electric Works, Bloomfield, N. J. Prof. Harry E. Clifford, of Harvard University, was toastmaster, and Mr. N. J. Neall, Boston, was chairman of the committee on arrangements.

Mr. Tripp delivered a powerful address upon the anti-trust legislation now under consideration at Wash-

ington, expanding somewhat upon the ideas expressed by him at the recent annual meeting of the Chamber of Commerce of the United States at Washington. An abstract of Mr. Tripp's Boston address appeared in these columns March 7. The speaker reviewed the salient features of the so-called "Five Brothers" bills and urged their careful consideration by all engineers and other persons interested in the commercial prosperity of the country.

Dr. Kennelly emphasized the importance of the engineer interesting himself in public affairs and outlined the purposes of the International Electrotechnical Commission, paying eloquent tribute to the linguistic work of President Mailloux in the deliberations of that body. He expressed the hope that international specifications would be forthcoming which would enable engineers to standardize machinery ratings on the basis of the commission's definition. President Mailloux expressed warm appreciation of the work of Dr. Kennelly on the commission, commented upon the growing spirit of fraternity among engineers, and in concurrence with President Hartness and Dr. Franklin emphasized the increasing usefulness of the engineer in modern civilization.

Anti-Trust Legislation

Two of the committees of Congress working on the administration anti-trust legislation came to a full stop during last week. The sub-committee of the House committee on commerce, which has charge of drafting a new bill to deal with the proposed interstate trade commission, found that there are almost insurmountable objections to the proposed publicity features of the measure. The Senate committee on interstate commerce, on the other hand, which has been holding hearings on Senator Newland's bill for the regulation of trade relations, has developed strong objection on the part of influential Senators and Representatives to adding anything to the statutes that will serve to change the Sherman law. The House committee on the judiciary, the other committee of Congress considering trust legislation, however, continued its hearings.

In last week's issue was published information of interest to the electrical industry brought out at the hearings before the House committee on the judiciary. This had to do chiefly with the fixing of resale prices on electrical appliances. The viewpoint of a representative of a large holding company is given in what follows.

Mr. Bernard Flexner, Representing Middle West Utilities Company

Mr. Bernard Flexner, representing the Middle West Utilities Company, Chicago, Ill., stated that a holding company owning the securities of gas and electric light utilities should be excluded from the operation of a statute affecting holding companies. The Middle West Utilities Company holds the securities of electric light properties in widely separated localities. All of these properties are operated by domestic corporations of the states containing the localities. Most of the states have public service commissions and the very thing that it would be desired to accomplish is being done by the states themselves. Companies which hold the securities of various operating companies make it possible to develop in the communities in which operations are conducted a character of service that otherwise would have been absolutely impossible. In Illinois, for instance, the operating Illinois corporation has taken over and is operating about 100 utilities in 100 different municipalities. Before these properties were brought together most of the communities were getting electric light only at night. Now they have twenty-four-hour service. The tendency in prices everywhere has been to lower.

The question of business of an interstate nature was brought up, and Mr. Flexner said that electricity was transmitted from one state to another. It would interfere very considerably with legitimate development of business to reach holding companies of this character where they do not present the elements of competition and cannot present such elements. Congress has recognized utilities as monopolies to be regulated and every state has recognized them as monopolies. The purpose of public service commission laws is to create a condition of regulated monopoly with reference to this character of business.

With regard to the interlocking directorate bill, Mr. Flexner said that an exception ought to be made in favor of a corporation and its lawful subsidiaries.

Buffalo Electric Show

The Buffalo Electric Show was opened at Elmwood Music Hall, Buffalo, N. Y., on the evening of March 9, to continue throughout the week. It represents the concerted action of the electrical contractors, jobbers, manufacturers and the central-station interests, and if the attendance on the opening night is duplicated only in part the show will be a pronounced success. On the front wall of the auditorium is the largest electric sign ever built in Buffalo. It is 42 ft. wide and 20 ft. high and has script letters 15 ft. high reading "Electric Show." These are studded with clear-globe tungsten lamps and the blaze of light is visible a great distance away. The booths within the hall are tastefully arranged and are grouped around a great fountain in the center, within which the spraying water is tinted with all the hues of the rainbow by hidden lamps. The general color scheme of the show is white. The hall girders overhead are hidden behind a billowy canopy of yellow and white bunting radiant in the brightness of numer ous electric lamps, most of which are invisible. From the ceiling are suspended baskets containing large tungsten lamps, and in spite of the large volume of light everything is arranged so that there is no glare.

The Buffalo General Electric Company has a "house electric" near the entrance, in which the convenience, cleanliness and desirability of electricity in the home are demonstrated. The usual array of household cooking devices and conveniences is shown. The Cataract Power & Conduit Company, which distributes the energy sent from Niagara Falls, has an educational exhibit to impress upon the public the overwhelming importance of electricity as an aid to commerce, and a miniature substation occupies two booths. The electrical contractors and supply houses show various wiring devices, appliances and lighting fixtures. In fact, the entire show is pre-eminently one to impress the householder and small manufacturer with the advantages of electricity. One of the finest exhibits of electrical apparatus of all sorts is that of the Robertscn-Cataract Company, which occupies the entire west end of the hall. The exhibit is divided into three main divisions, one for displaying lighting fixtures, another for the display of electric household and cooking appliances and the center space being occupied by a large exhibit of electrical apparatus and supplies, including almost everything needed for electrical installations, from the outdoor pole-line material to the finished job in the home or factory. Among the large electrical contracting and supply house exhibits are those of McCarthy Brothers & Ford, the Western Electric Com-

pany, the Electric Shop, the W. C. Jaynes Electrical Company, the J. C. Sterns Electrical Company, the Holtzer-Cabot Company, the Johnson-Wahle Electric Company, the Tower Electric Sales Company, the Buffalo Electric Contracting Company, the Thordarson Electric Manufacturing Company, the Sterns Electric Equipment Company, J. H. Vail, H. J. Wood & Company, H. I. Sackett Electric Company and J. N. Adam & Company.

Effectiveness in Central-Station Organization

Prof. John Price Jackson, formerly dean of the Engineering School of Pennsylvania State College and now Commissioner of the Department of Labor and Industry for the State of Pennsylvania, addressed the Philadelphia Section of the National Electric Light Association recently on the topic "Co-operation and Effectiveness in Industrial Organizations." The speaker declared that such effectiveness depends on, first, the right attitude of the employee toward the company and, second, a due appreciation on the part of the company of the service of its employees. The latter should not indulge in criticism of the company among themselves and much less to outsiders. Employers, on the other hand, must remember that their men are human and that improvements in working conditions, comfort, safety, etc., can do more toward bringing about effective organization than caustic criticism or arrogant methods can ever accomplish.

Last month the engineering department branch of the Philadelphia Section was addressed by Mr. Albert R. Granger, manager of the Beacon Light Company, Chester, Pa., and Mr. John E. Melloy, electrical superintendent of the same company. At the Feb. 6 meeting of the meter-department branch, Mr. A. R. Cordner read a paper on "Economic Factors in Central-Station Development."

Power and Machinery Contracts Signed for Large Reversing Steel Mill at Massillon, Ohio

The Massillon (Ohio) Rolling Mill Company, now operating a sheet mill, is formulating plans which contemplate the installation of six open-hearth furnaces, a 26-in. blooming mill and a 34-in. bar mill, in addition to a stamping and enameling plant and other fabricating mills. The total output of the plant will be 150,000 tons of steel annually, 60,000 tons of which will go to the sheet mill, while the remainder will be made into high-grade nickel and vanadium alloy steels. Contracts for the electrical apparatus have been signed with the Westinghouse Electric & Manufacturing Company, while the contract for electrical energy, to be supplied from the mains of the Massillon Electric & Gas Company, was closed by Mr. R. E. Burger, manager of the Henry L. Doherty property at Elyria, Ohio. Energy will be taken from the electric-service company's mains at 2300 volts and will drive a directly connected induction-motor-generator set delivering direct current for the large mill motor. This set will be equipped with a 100-ton laminated flywheel, having a peripheral speed of about 4 miles a minute. The blooming mill will be driven by a direct-current reversing motor, reversing being accomplished through control apparatus connected in the generator-field winding. The bar mill will be driven by a 2000-hp induction motor. It has been estimated that the connected load of the mill will be 7000 hp and that the maximum demand will be in the neighborhood of 2400 kw.

Telephones of the United States

Preliminary figures of the forthcoming quinquennial report on telephones of the United States have been given out by the Bureau of the Census. The statistics relate to the years ended Dec. 31, 1902, 1907 and 1912, and include the total wire mileage and the total number of telephones reported for all systems in the United States that were in operation all or any part of those years. They do not include private telephone lines used exclusively for communication between departments of the same establishment unless connected with lines elsewhere through a private branch or exchange. The number of telephones includes those furnishing service through private branch exchanges, local pay and outlying toll stations.

During the year 1912 the length of wire used on the telephone lines of the United States amounted to

TELEPHONE STATISTICS OF THE UNITED STATES FOR 1912

	Year	Miles of Wire	Number of Telephones	Estimated Number of Messages or Talks*
United States	1912	20,248,326	8,729,592	13,735,658,245†
	1907	12,999,364	6,118,578	10,400,433,958†
	1902	4,900,451	2,371,044	5,070,554,553
Bell Telephone System	1912	15,133,186	5,087,027	9,133,226,836
	1907	8,947,266	3,132,063	6,401,044,799
	1902	3,387,924	1,317,178	3,074,530,060
All other companies and systems	1912	5,115,140	3,642,565	4,602,431,409
	1907	4,052,098	2,986,515	3,999,389,159
	1902	1,512,527	1,053,866	1,996,024,493

*The number of messages reported by the Bell Telephone System includes only completed calls, while the figures for all other companies may include some original calls not necessarily completed, such as calls that the operator reports as "Line busy" or "Does not answer."

†Exclusive of companies with an annual income of less than $5,000.

20,248,326 miles, an increase of 313.2 per cent during the decade. There were in use 8,729,592 telephones, an increase of 268.2 per cent during the ten years. Of these, the Bell system increased by 137.8 per cent during the period from 1902 to 1907 and by 62.4 per cent from 1907 to 1912. During the same periods the number of telephones reported by all other companies and systems increased 183.4 per cent and 22 per cent respectively. In 1902 the Bell system controlled 69.1 per cent of the wire and 55.6 per cent of the telephones in use, and in 1912 this system controlled 74.7 per cent of the wire and 58.3 per cent of the telephones. The proportion of the total wire mileage and total number of telephones owned by the Bell system has increased during the decade, while that owned by the independent companies has decreased.

While accurate statistics cannot be compiled on the number of messages transmitted, it is estimated that there were 13,735,658,245 messages sent over the telephone lines of companies which had an income of at least $5,000 during 1912. It is impossible to obtain even an estimate of the number of conversations over private branch wires and the party lines which do not require interconnection at the public or central exchanges. No estimates were required concerning the number of messages for the 1,402,844 telephones on the lines of small companies which had an income of less than $5,000 during 1912. Messages for the smaller systems were included to some extent at the census of 1902; therefore, the statistics of messages reported for the three periods are not strictly comparable and they should not be considered as representing the total amount of business transacted by telephone systems of the United States during the year 1912. The figures in detail are shown in the accompanying table.

Public Service Commission News

Maryland Commission

That the order of the Maryland Public Service Commission directing the Curtis Bay Electric Light & Water Company to extend its service into the town of Brooklyn, Anne Arundel County, was unlawful and unreasonable is the gist of an opinion handed down by the Court of Appeals. The opinion affirms the decree of the Circuit Court for Baltimore City. The commission passed its order upon petition of the Brooklyn Improvement Association. It reached the conclusion that the company could well undertake the extension on the prospect of obtaining new customers.

New Jersey Commission

The Board of Public Utility Commissioners of New Jersey has declined to hear the application of the township of South Orange that the Public Service Electric Company incorporate a clause in its street-lighting contract permitting the acquisition of its equipment by any other company if in the future such other company should obtain a lighting contract.

The Supreme Court has handed down a decision affirming the authority of the Board of Public Utility Commissioners to refuse to approve of franchises granted by municipalities if it deems that such utility is not essential for public benefit and convenience. The court, therefore, refuses the mandamus writs applied for by the Eastern Telephone & Telegraph Company, to which a franchise was recently granted by the Cape May Board of Freeholders, the franchise being later denied by the utility board.

California Commission

The Consolidated Utilities Company, Compton, and the Glendora Light & Power Company have filed applications with the Railroad Commission of California asking authority to transfer their properties to the Pacific Light & Power Corporation.

The Western States Gas & Electric Company has filed an application with the Railroad Commission of California for authority to issue $219,000 first mortgage refunding 5 per cent gold bonds which the applicant wishes to sell at 82½.

Massachusetts Commission

Chairman F. E. Barker of the Gas and Electric Light Commission advocated extending the commission's powers at a recent hearing by the legislative committee on public lighting on the bill giving the commission final jurisdiction over the issue of securities by utilities under its supervision. The commission's bill is designed to avoid the recurrence of such a reversal of the board's decisions as was brought about in the recent Fall River Gas Works Company case, where the Supreme Court of the State required the board to authorize a stock issue which the commission had refused to approve on the ground that it was inconsistent with the public interest (Fall River Gas Works vs. Gas and Electric Light Commissioners, 214 Mass., 529). Under its provisions no securities could be issued save with the approval of the board as a court of last resort, no court appeal being allowed in case of an adverse decision. The bill is designed to prevent the accumulation of unduly large surpluses and the issue of new securities in the face of what are virtually stock dividends, in the commission's opinion. The bill was opposed by Mr. A. A. Ballantine, for the Stone & Webster Management Association, and Mr. E. W. Burdett, for the Massachusetts Electric Lighting Association, who contended that the practical control of surplus accumulation is sufficiently lodged in the board's rate-making powers, which can easily be invoked upon petition by aggrieved parties.

Current News Notes

MUNICIPAL LIGHTING ACTIVITY IN PASADENA.—The municipal electric-lighting plant in Pasadena, Cal., has now about 6000 meter connections, and Mr. C. W. Koiner, the general manager, is said to have recommended that the minimum monthly charge be reduced to 50 cents.

* * *

LOUISVILLE & NASHVILLE-WESTERN UNION SUIT.—The Louisville & Nashville Railroad Company has filed a bill of exceptions to the recent decision of Judge Walter Evans, of the federal court at Louisville, Ky., granting the Western Union Telegraph Company a new trial after a jury had awarded the railroad company $500,000 for the use of its right-of-way by the Western Union.

* * *

BETTER INDUSTRIAL RELATIONS EXHIBIT.—A "Better Industrial Relations Exhibit" is to be held April 18 to 25 at 2 West Sixty-fourth Street, New York City, at which will be shown devices in modern business which tend to make more harmonious the relations between employer and employee and to better the conditions of employment. The "Business Men's Group" of the Society for Ethical Culture, New York, will have charge of the exhibit.

* * *

WHAT ONE CENTRAL-STATION COMPANY DID FOR ELECTRIC VEHICLES.—When the Union Electric Light & Power Company started to push the electric-vehicle business in St. Louis seven years ago there were but eleven "electrics" operating on the streets of the city. To-day there are 600 pleasure cars and 150 trucks. A census taken when the company decided to discontinue its electric-vehicle business showed that one-fourth of all pleasure cars operating in the city had been sold by the central-station company.

* * *

TRANSFORMERS IN CHICAGO.—In a recent paper Mr. W. G. Kelley, of the distribution division of the engineering department of the Commonwealth Edison Company of Chicago, said that during the period from 1902 to 1913 the number of transformers connected with the system increased from 1750 to 14,500 and their rating increased from 12,700 kw to 127,500 kw, the average size increasing from 6 kw in 1902 to 8.5 kw in 1913. This shows an increase in the density of the load as well as the extension of the system.

* * *

TESTIMONIAL DINNER TO DR. SAMUEL SHELDON.—A testimonial dinner will be tendered to Dr. Samuel Sheldon at the Hotel Astor on March 21 to celebrate a quarter of a century of service as professor at the Polytechnic Institute of Brooklyn. Undergraduates, alumni, friends and professional associates are expected to come from various parts of the country to join in the celebration. Mr. T. C. Martin will preside as toastmaster and the speakers will include Messrs. S. O. Edmonds, Ralph W. Pope, Dr. L. W. Atkinson and W. L. Bliss.

* * *

GRIDS FOR SPOT RESISTANCE LAMP.—In the article "Resistance Grid for Spot Lamp" appearing on page 273 in the Jan. 31 issue an error was made in stating the size and length of the resistance wire to be used. Instead of employing 13 ft. of No. 18 IaIa resistance wire as recommended, 90 ft. of No. 10 wire of the same material should be used. The temperature finally attained by this wire would be about 700 deg. Fahr. under the conditions imposed. If a lower temperature rise of say 500 deg. Fahr. is desired, about 215 ft. of No. 6 wire may be employed.

SAN FRANCISCO EXPOSITION BUILDINGS READY JULY 1.—The main exhibit palaces of the Panama-Pacific International Exposition, to be held at San Francisco in 1915, will contain approximately 60,000 exhibits from all parts of the world. Allotment of space will shortly be taken up and the installation of exhibits in the buildings will begin about July 1, thus giving exhibitors nearly nine months to get ready. More than 7000 applications for concessions have been received. Already 212 national and international congresses have signified their intention to meet in San Francisco during 1915, and it is probable that the number of organized bodies which will assemble during the exposition will reach 500.

* * *

DOLLARS-AND-CENTS VALUE OF GENERATING-STATION EFFICIENCY.—In answer to a question at a recent meeting of the Commonwealth Edison Company Section of the National Electric Light Association, Mr. G. E. McKana, of the statistical department of the company, said that it is probable that the present coal consumption of the company would be double what it is if the generating units of to-day were no more efficient than the reciprocating-engine units of the Harrison Street station twenty years ago. Under such conditions the annual coal consumption would be 2,500,000 tons a year. If the extra coal burned is worth no more than a dollar a ton, the annual saving is $1,250,000, which, capitalized at 5 per cent, represents $25,000,000.

* * *

SOCIETY MEETINGS

PHILADELPHIA SECTION, I. E. S.—The next meeting of the Philadelphia Section of the Illuminating Engineering Society will be held March 20 at the Engineers' Club, 1317 Spruce Street, Philadelphia. The usual dinner will precede the meeting. At the session Mr. F. D Bartlett will present a paper on "Lighting and Signaling Systems of Subways," and Prof. James Barnes will speak on "The Sun—the Master Lamp."

* * *

KENTUCKY JOVIANS TO REJUVENATE.—The first rejuvenation of the Jovian Order in Kentucky will be held at the Seelbach Hotel, Louisville, March 17. The rejuvenation will be a joint affair, Louisville, Lexington, Ky., and Evansville, Ind., participating. Jupiter W. N. Matthews, St. Louis, will officiate, and Messrs. James Clark, Jr., statesman for the Louisville district, and C. J. Eaton, Lexington, who is statesman in that territory, are in charge of the arrangements. It is expected to initiate 100 candidates at the rejuvenation. The banquet which will follow will be attended by 125 Jovians.

* * *

ELECTRICAL ASSOCIATION OF WILMINGTON, N. C.—At the March 5 meeting of the Electrical Association of Wilmington, N. C., Mr. W. C. Andrews, Orange, N. J., gave a talk on the construction and operation of the Edison alkaline nickel-iron storage battery. The Wilmington association is now in its second season, with a membership of sixty. Meetings are held monthly. At the April meeting energy-consuming appliances will be discussed in a paper by Mr. R. H. Bouligny, Richmond, Va. The president of the association is Mr. Raymond Hunt, superintendent of the Tide Water Power Company, and its vice-president is Mr. Charles R. Sugg, of the Atlantic Coast Line.

* * *

THE 3750-KW DIRECT-CURRENT TURBO-GENERATORS AT CLEVELAND.—At the Feb. 23 meeting of the Cleveland Section of the American Institute of Electrical Engineers, which was held in the new office building of the Cleveland Electric Illuminating Company, Mr. H. L. Wallau, electrical engineer for the company, presented a paper describing the performance of the two 3750-kw, 13,650-amp, 275-volt direct-current turbo-generators installed at Cleveland about a year ago. The generators are driven through McAlpin reduction gears, giving an armature peripheral speed of 8500 ft. per minute and a commutator speed of 4250 ft. per minute. Each turbine weighs 153,000 lb., the gearing 40,000 lb., and the generator 163,000 lb.

* * *

SOCIETY FOR ELECTRICAL DEVELOPMENT TO DECIDE ON PLANS.—The executive committee of the Society for Electrical Development, Inc., met in New York on March 11 and discussed several important questions in connection with future activities of the society. The following committee was appointed to meet at the society's offices on March 17 to reach a final decision on plans and put them into effect: Mr. Henry L. Doherty, of New York; Mr. N. H. Boynton, of Cleveland; Mr. George Williams, of New York; Mr. J. Robert Crouse, of Cleveland; Mr. W. E. Robertson, of Buffalo; Mr. F. H. Gale, of Schenectady; Mr. J. R. Strong, of New York; Mr. E. W. Lloyd, of Chicago; Mr. J. C. McQuiston, of Pittsburgh; Mr. J. M. Wakeman, of New York, and Mr. S. L. Coles, secretary of the society.

* * *

WESTERN SOCIETY OF ENGINEERS AND UTILITIES.—An extra meeting of the Western Society of Engineers will be held Monday, March 16, at 8 p. m., in the rooms of the society at Chicago. At the annual meeting of this society in January Mr. M. E. Cooley, dean of the College of Engineering of the University of Michigan, delivered an address on "Factors Determining a Reasonable Charge for Public Utility Service." The meeting on Monday night will be practically a discussion of the subject brought up by Dean Cooley. A paper on "Public Utility Regulation from the Investors' Standpoint" will be presented by Mr. Andrew Cooke. Mr. Samuel O. Dunn, editor of the *Railway Age Gazette*, will discuss "Public Utility Valuation from the Railroad Point of View." "Rate Determination of Public Utilities from the Standpoint of the Student of Public Relations" is the subject of a paper to be presented by Mr. Harold Almert, formerly associated with H. M. Byllesby & Company, of Chicago.

* * *

MEETING OF CHICAGO JOVIANS.—A very successful rejuvenation and joviation of the Jovian Order was held in the Hotel Sherman, Chicago, on the night of March 5. The rejuvenation was attended by about 230 men, including fifty-eight candidates, who were initiated into the order. At the preliminary dinner Mr. T. C. Ringgold presided as toastmaster. Mr. F. W. Harvey, Jr., alternate statesman for Illinois, presented an ingenious plan by which contributions poured in for the local work of the Jovians until $297 had been received. The finances of the Chicago Jovian League are now in a satisfactory condition. Mr. Ell C. Bennett, of St. Louis, the Mercury of the order and in charge of the central office, was present and made a short speech, emphasizing particularly the work of the commercial division. Mr. Sam A. Hobson, Past-Jupiter Three, made a speech in which he said that in his judgment Chicago ought to elect the next Jupiter, and a movement to that end should be started at once. At the conclusion of Mr. Hobson's speech Mr. A. A. Gray, statesman-at-large, arose and, on behalf of the Jovians of Chicago, suggested as the next Jupiter of the Jovian Order Mr. Homer E. Niesz. After the dinner the initiation was conducted in an impressive manner, and this was followed by an excellent wrestling bout staged by professionals for the entertainment of the Jovians.

Transmission Plant Without a Switchboard

Comparison of the constant-current Thury system with the alternating-current three-phase system for transmission purposes. By Dr. Louis Bell

THE writer had long wished to see in operation a transmission plant on the direct-current constant-current system and to judge something of its actual conditions of working in everyday use. Not long ago the opportunity came.

In the United States electrical engineers instinctively call to mind when constant-current working is mentioned the old arc-light plants, with generators in small units only too apt to produce pin-wheel effects at the commutator, and operating now and then a few small and scattered motors in defiance of all decent regard for standard practice, not to say human safety. A system with a considerable motor load lingered on in San Francisco, if memory serves aright, long after its appointed time, and used to be sought out as a sort of electrical curio.

Any one who goes to Switzerland with preconceived notions of such sort is likely to get a sudden shock when he is brought to the realization that as developed by the masterly skill of M. Thury the constant - current system is not a system of distribution but of transmission, is wonderfully simple instead of exasperatingly complex, and looks forward to long underground cables instead of backward to the rickety lines of tattered underwriters' wire that rise before the mind's eye at the mention of constant current.

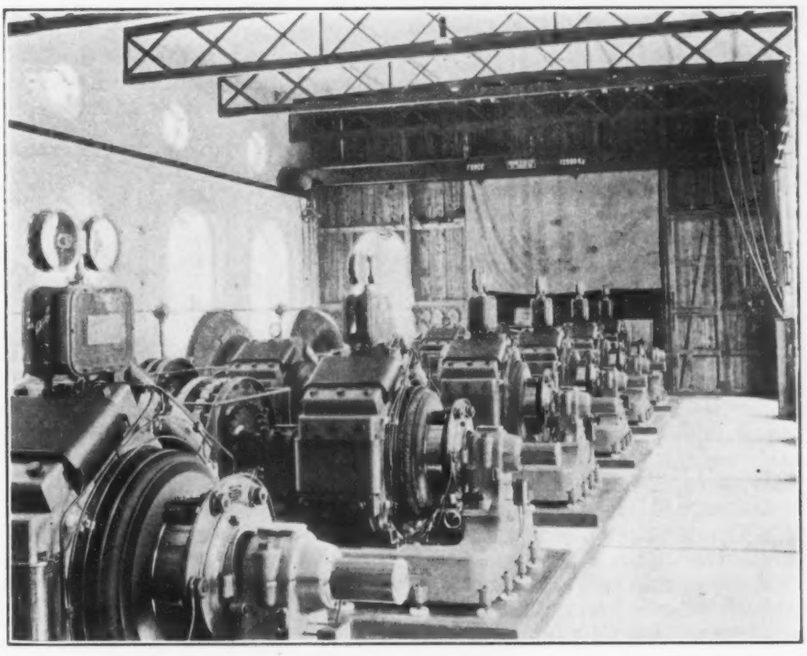


FIG. 1—INTERIOR OF ST. MAURICE-LAUSANNE POWER STATION, SHOWING SIX GENERATING SETS

In fact, after looking into the matter rather carefully if the writer were asked to name the most fundamental characteristic feature of the Thury sytem he would say that it is simplicity in practical operation. It is perfectly true that the generating units must be in series if high voltage is to be employed—likewise the receiving motors; but this seems to be the end of the matter, and the stations as a whole are vastly simpler than the ordinary three-phase station, and in the writer's judgment a good deal less likely to go wrong. By this is not meant that such condition is necessary, but merely that it exists in stations as they are. In fact, the auxiliary and switchboard equipment of the ordinary transmission station is in large measure needless, is outrageously expensive and is a prolific source of operative troubles. But it is a fact that quite regularly confronts one with the result that it is rather a serious task to learn the connections and devices in a new station so as to work it with facility—relative facility—for there is always a capital chance for mistakes in an emergency.

On the other hand, any intelligent station man ought to be able to get the knack of handling a constant-current station inside of the twenty-four hours needed to see it under its normal cycle of load conditions and thereafter to operate it with comfortable facility. In fact, the absence of all the switchboard and transformer complications not only simplifies running but quite recoups one for the necessarily greater expense of the generators and motors. To explain what is meant one of the older and less simple plants on the constant-current system, which the writer had the pleasure of visiting in company with M. Thury himself, is described in the following account.

The purpose was to visit one of the recent plants of the great Moutier-Lyons transmissions, but owing to complicated railway connections it proved so inaccessible that at the suggestion of M. Thury the day was spent looking over the St. Maurice-Lausanne plant, which for a decade has been doing excellent and remarkably reliable work in bringing the power of the upper Rhône to the service of the municipality of Lausanne. It is a plant not now remarkable for size or voltage—about 4000 kw at full load and voltage about 25,000. The distance of transmission is 56 km (about 35 miles), so that the plant is typical of the ordinary run of medium-sized systems commonly found in this country working at from 20,000 volts to 25,000 volts, three-phase.

St. Maurice lies southeast of the Lake of Geneva in the narrow reach of the Rhône valley that leads up toward the Simplon, and is reached by train along the

bank of the lake from Geneva in a couple of hours. The power station is a mile or so down the valley from the village—a valley contracted to a scant mile in width with towering cliffs, bristling with rather well-concealed fortifications, on each side.

The headworks are about 500 m from the station and present no remarkable features. Two big pen-

FIG. 2—ST. MAURICE-LAUSANNE POWER STATION

stocks, about 3 m in diameter, lead the water down to the power station—a long concrete structure half hidden in a hollow with a commodious house at one end and merely sheathed in at the other to permit of a future extension to double its capacity. As shown, it is laid out quite after the usual American plan, with generating sets arranged crosswise and wheel discharge under the building. The six draft tubes of the present installation are shown passing at an angle into the tailrace. The wheels themselves are ordinary turbines built by Escher, Wyss & Company, and the head at which they work is moderate, in the neighborhood of 30 m. The penstocks are protected by standpipes.

The interior of the power house contains six generating sets each composed of a turbine directly connected to a pair of Thury generators. Each of these machines gives a constant current of 150 amp at a maximum pressure of 2200 volts. Each thus gives 330 kw and each generating unit 660 kw. Each pair is connected by a big insulating flexible coupling, and a similar coupling unites the pair to the wheel. The nature of this coupling is well shown between the second pair of machines in the foreground of Fig. 1. It consists of two large opposed plates carrying alternately disposed pins incased in heavy rubber cylinders.

All six sets are governed for constant current by a single governor set to control the wheel speeds and working by pressure cylinders somewhat after the manner of the familiar Lombard governor. In addition, each generator set has its own little servo-motor to work the gates in stopping and starting. Each pair of generators has mounted upon it an ammeter and voltmeter and is equipped with an automatic short-circuiting switch, shown as a little box below the end bearing, to prevent the machines getting away from control as motors in case of accident. A pillar near the waterwheel end of each pair carries a very simple short-circuiting switch for putting the unit into action.

Control of Main Units

And this is all. The main switchboard of the station, if one may by courtesy call it so, is shown in Fig. 5. It is a glass-doored cabinet fastened to the wall and containing an ammeter, a voltmeter graduated to thousands of volts, and as regards the main plant nothing else. The rest of the meager contents merely supply and control the little motor that works the governor and connect the governor itself. There are in the front corner of the power house next the tailrace two little 80-kw, three-phase machines for a local circuit into St. Maurice, and this pair has more of incidental equipment and switchboard than all the rest of the plant together.

Literally the main transmission plant has no switchboard at all and is handled with a facility that is little short of amusing. If, for instance, the load is coming on and one wants to throw in another unit, he steps to a waterwheel (see Fig. 3) and gives a twist to the little hand-wheel of its servo-motor, which device is mostly hidden behind the switch post in the figure. As the short-circuited machine starts up he reaches out and opens the switch at the post as the ammeter on the machine comes approximately to 150, and the governor does the rest.

In throwing off a set the servo-motor valve is closed and the short-circuiting switch thrown in when the voltmeter indicates a couple of hundred volts, and that is all there is to it. The writer saw the performance several times, both to illustrate the method and also the working in ordinary service, and he can readily believe the operator's statement that full load could actually be shifted from one set to another in ten seconds. Ordinarily three or four of the sets are in use, the others being thrown in as the peak load comes on. The voltmeter in Fig. 5 shows about 12,000, and that was on a Sunday

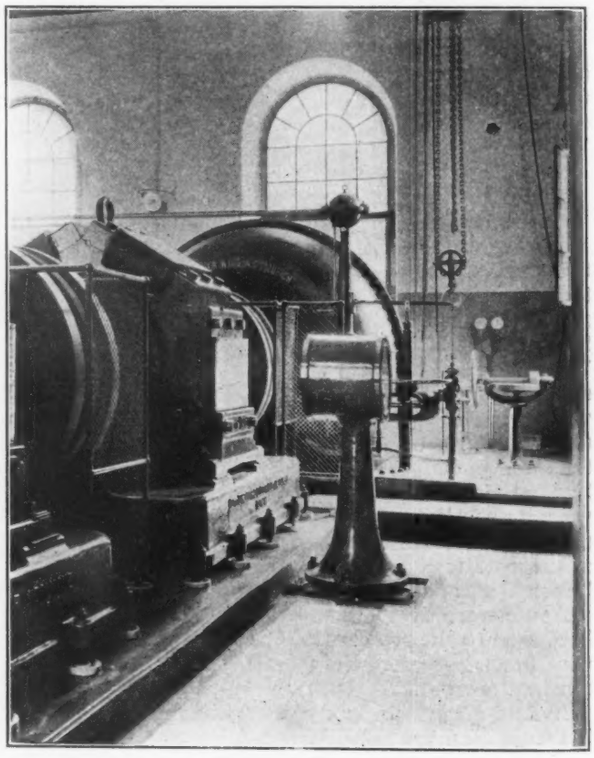


FIG. 3—METHOD OF SUPPORTING MACHINES ON PORCELAIN BLOCKS

afternoon. At the peak all machines go in and this pressure is doubled. Were this same plant being built to-day it would be much simpler than here shown. There would be only three sets instead of six, and each of these would be merely a double armature machine with three bearings, coupled directly to the waterwheel with a single insulating clutch.

Of course, in any such plant the machines must be carefully insulated from earth, and Fig. 3 shows very well the method by which it is done by porcelain blocks on which the generator rests. In later plants the machine foundations themselves are insulated instead, and the floor is also pretty effectively insulated, so that, as is the case with the plant inspected, one can work about the generators quite in safety.

Terminal Station

The receiving plant for a system of this kind is similar to the generating plant, but with the constant-current motor directly coupled to three-phase generators wound for the distributing voltage of the final system. In this case a constant-speed governor is used which regulates the motors by brush shifting. It is found in practice that such regulation can be made very sensitive and exact so that the motors on the distributing lines are held at speed if anything rather better than in the case of transmission directly from three-phase generators taking operation year in and year out. For with a constant current the speed of the driven machinery does not depend on that of the prime mover, and fluctuations in head are no longer a cause of worry except in so far as they may operate to limit the ultimate output.

Of course, there is greater loss in these motor-generators than there would be in transformers, but one must really compare with two transformations instead of one, and when supplying railway load, for example, the difference becomes very small.

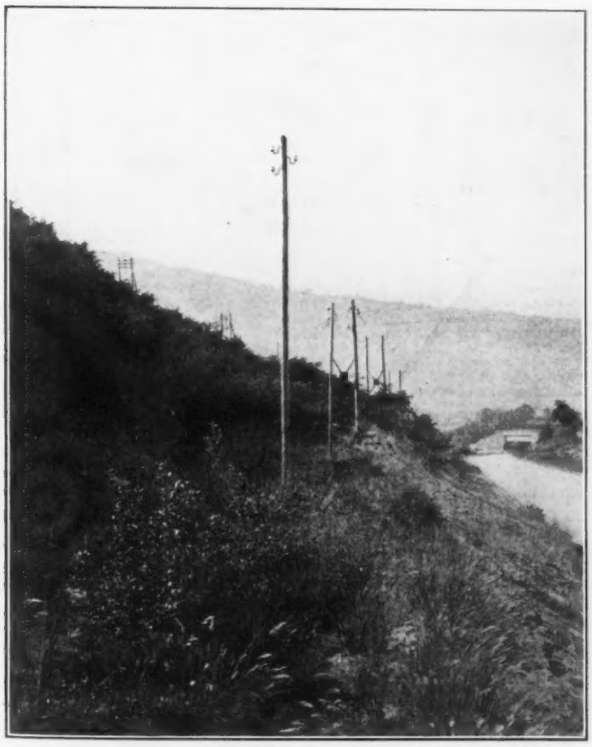


FIG. 4—TRANSMISSION LINE FROM ST. MAURICE TO LAUSANNE

Transmission Line

The transmission-line problem is an interesting one. One must face squarely the realization that the line loss, whatever it may be, is a constant quantity quite irrespective of load. On the other hand, the top voltage which determines the factor of safety in the insulation only hits the constant-current system at the peak and there is no out-of-phase component for which one has to make allowance in the line. Taking the power-factor into consideration, together with the losses it indirectly occasions, the average line losses in the two cases are nearer together than first thought would indicate.

The line from St. Maurice to Lausanne, shown in Fig. 4, is a very simple one on the ordinary Swiss wooden-pole construction with rather small porcelain insulators. In the illustration the little three-phase circuit supplying St. Maurice is seen on the left and the main circuit appears crossing the river and running up toward St. Maurice on its own poles. It will be noticed that there is only a single two-wire circuit. For all practical purposes, however, it is a duplicate circuit, for either of the wires can be used earthed to transmit full load without loss of efficiency. In fact, this plant has actually been so operated for long periods, and the use of a return metallic circuit is quite needless save as giving duplication and as a concession to popular prejudice. Earthing 150-amp constant current is quite a different proposition from earthing an alternating-current constant-potential circuit.

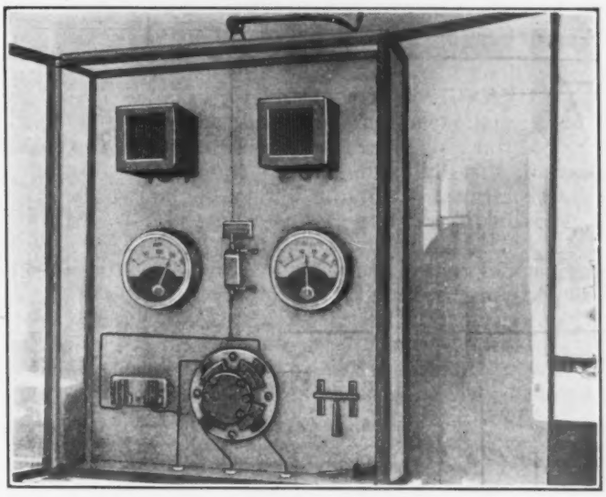


FIG. 5—INSTRUMENT BOARD

This possibility gives assurance of reliable service and such it has proved to afford. Protection against lightning is exceptionally easy since heavy inductance can be put in the line without any unpleasant results. Likewise, the whole brood of troubles connected with resonance drop out of sight, so that as regards the line the operator can rest comfortably. All in all, despite the number of units and the twelve high-voltage commutators the system seems extraordinarily easy to operate. The commutators also show no trace of sparking and have that nice glossy look that bespeaks smooth operation.

In all this the writer is not presenting a brief for the constant-current system, but must confess that it impresses one very strongly as being for appropriate cases most useful, and beautifully simple from the hard practical standpoint of the man who has to run it. A station without a switchboard certainly appeals to anyone familiar with the dozens of switches piled up in the ordinary alternating-current plant and each one looking for trouble. Decidedly, anyone who thinks that standard three-phase generators, transformers and switchboard panels make up the whole thing in modern electrical transmission would do well to take off his blinders and look about a bit. A visit to Switzerland would, one may safely predict, not fail of its effect on the most obstinate of skeptics.

Central-Station Statistics of the United States

Preliminary figures of the Census Bureau on the electric-lighting stations of the country for 1912, with comparisons for 1907 and 1902—Statistics for individual states and geographical sections

ADVANCE figures of the forthcoming quinquennial report on the central stations of the continental United States (exclusive of Alaska, Hawaii, the Philippine Islands and Porto Rico) have just been given out by the Bureau of the Census.

The statistics relate to the years ended Dec. 31 for 1912 and 1907 and June 30 for 1902, and cover both commercial and municipal electric plants. They do not include electric plants operated by factories, hotels, etc., which consume the energy generated, those operated by the federal government and state institutions, or plants that were idle or in course of construction at the time the census was taken.

The figures as given for the continental United States show general gains for the decade 1902-1912. The number of commercial stations or plants increased from 2805 in 1902 to 3659 in 1912, or 30 per cent. The number of municipal plants increased from 815 in 1902 to 1562 in 1912, or 92 per cent. The total income for 1912 amounted to $302,115,599, as compared with $85,700,605 in 1902, or an increase of 252 per cent. The total expenses, including salaries and wages, in 1912, amounted to $234,419,478, as compared with $68,081,375 in 1902, or an increase of 244 per cent. The total number of persons employed in 1912 was 79,335, as compared with 30,326 in 1902, or an increase of 162 per cent. The total horse-power of the steam engines and steam turbines was 4,946,532 in 1912, as compared with 1,394,395 in 1902, or an increase of 255 per cent. The horse-power of the waterwheels was 2,471,081 in 1912 as compared with 438,472 in 1902, or an increase of 464 per cent. The output of stations amounted to 11,502,963,006 kw-hr. in 1912, as compared with 2,507,051,115 in 1902, or an increase of 359 per cent. The estimated number of arc lamps wired for service in 1912 was 505,395, as compared with 385,698 in 1902, or an increase of 31 per cent. Incandescent and other varieties of lamps wired for service, however, numbered 76,507,142 in 1912, as compared with 18,194,044 in 1902, or an increase of 320 per cent. The horse-power rating of the stationary motors served with electricity amounted to 4,130,619 in 1912, as compared with 438,005 in 1902, or an increase of 843 per cent. The figures are shown in detail in Table I.

It should be pointed out that the government is careful to specify that the term "station" as used by the Census Bureau may represent a single electric station or a number of stations operated under the same ownership, hence the difference in the number of stations reported by the government and those contained in the McGraw Electrical Directory, which showed 5823 in October, 1912.

The reports for electric railways made by the Census Bureau contain statistics for 169 companies which report central-station work. These are counted as a part of the electric-railway systems and are not included in the total number of 5221 establishments shown in the central-station report. Reports of important isolated stations have also been excluded unless a considerable quantity of electrical energy is sold for commercial purposes.

Reports by Geographical Sections

For convenience the country has been divided into six sections and the statistics for these six sections compiled separately from the reports as sent out by the Census Bureau. These geographical sections are not those followed by the Census Bureau, and it will be noted that there is some disparity between the figures given by the Census Bureau in Table I and those carefully compiled from the census reports by individual states in the office of the *Electrical World*. The differences, which are considerable in some cases, are doubtless due to typographical errors in the preliminary reports as sent out by the Census Bureau.

TABLE I—CENTRAL-STATION STATISTICS OF THE CONTINENTAL UNITED STATES

	1912	1907	1902	Per Cent of Increase: 1902–1912
Number of stations*	5,221	4,714	3,620	44.2
Commercial	3,659	3,462	2,805	30.4
Municipal	1,562	1,252	815	91.7
Total income†	$302,115,599	$175,642,338	$85,700,605	252.5
Light, heat, and power, including free service	$286,980,858	$169,614,691	$84,186,605	240.9
All other sources	$15,134,741	$6,027,647	$1,514,000	899.7
Total expenses, including salaries and wages‡	$234,419,478	$134,196,911	$68,081,375	244.3
Total number persons employed	79,335	47,632	30,326	161.6
Total horse-power	7,528,648	4,098,188	1,845,048	308.0
Steam engines and steam turbines:¶				
Number	7,844	8,054	6,295	24.6
Horse-power	4,946,532	2,693,273	1,394,395	254.6
Waterwheels:				
Number	2,933	2,481	1,390	111.0
Horse-power	2,471,081	1,349,087	438,472	463.6
Gas and oil engines:				
Number	1,116	463	165	576.4
Horse-power	111,635	55,828	12,181	811.5
Kw rating of generators	5,134,689	2,709,225	1,212,235	323.6
Output of stations, kw-hr.	11,502,963,006	5,862,276,737	2,507,051,115	358.8
Estimated number of lamps wired for service:				
Arc	505,395	§562,795	385,698	31.0
Incandescent and other varieties	76,507,142	§41,876,332	18,194,044	320.5
Stationary motors served:				
Number	435,473	167,184	101,064	330.9
Horse-power	4,130,619	1,649,026	438,005	843.1

*The term "station" as here used may represent a single electric station or a number of stations operated under the same ownership.

†Exclusive of $36,500,030 in 1912, $20,093,302 in 1907, and $7,703,574 in 1902, reported by street and electric railway companies as income from sale of electric energy for light or motor service or from sale of energy to other public service corporations.

‡In addition to salaries and wages, includes the cost of supplies and materials used for ordinary repairs and replacement, advertising, fuel, mechanical power, electrical energy purchased, taxes, charges for depreciation, and all other expenses incident to operation and maintenance.

¶Includes auxiliary engines.

§Includes, for purposes of comparison, 7082 arc and 267,997 incandescent lamps reported by the electric companies to light their own properties. Lamps used for such service were included in the total number reported in 1912.

The six divisions used comprise the New England States; the North Central States, including those north of the Mason and Dixon line and east of the Mississippi River; the Southeastern States, including those south of the Mason and Dixon line and east of the Mississippi River; the Middle Western States, which include the double row of states west of the Mississippi River stretching from Texas and Louisiana to the Canadian border; the Rocky Mountain States, which include those states between the Middle Western group and the three states on the Pacific Coast, and the Pacific Coast States.

New England States

The census figures for the New England States as a group and also by individual states were published in the *Electrical World* of Jan. 10, page 74, together with comments on the showing made.

North Central States

This division includes New York, New Jersey, Pennsylvania, Delaware, District of Columbia, Maryland, West Virginia, Ohio, Indiana, Michigan, Illinois and Wisconsin. In the reports by individual states Wisconsin is separated from its proper group because of the exigencies of typographical make-up. The great manufacturing centers are located in this group of states.

Over one-half of the total income from electricity in the United States and over one-third of the total output is reported from the North Central States. Over one-half of the horse-power of motors of the country also belongs to that section, the greater part of the arc lamps and almost 60 per cent of the incandescent lamps of the country. New York is the largest state in the country throughout, being first in population, in number of stations and total rating of generating equipment, in horse-power of steam engines and of waterwheels, in total output and in aggregate income. Its output is almost four times that of Pennsylvania and almost twice that of Illinois.

Southeastern States

This group includes Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama,, Mississippi, Tennessee and Kentucky.

The growth in the number of waterwheels and in horse-power of motors connected in that section during the last decade has been phenomenal. South Carolina especially showed great increases in water-power development and in output. The use of electricity in South Carolina is greater than in any other of the Southeastern States. It is the tenth state of the Union so far as output of kilowatt-hours is concerned, and from the aggregate income it is evident that the energy is sold very cheaply. As a section, the Southeastern is the smallest of the six divisions, the total output of the six states being only 797,000,000 kw-hr., almost half of which was generated in South Carolina.

Middle Western States

This group of states takes in the great agricultural section of the United States stretching from the Gulf of Mexico to Canada.

The eleven states in this section showed an output during 1912 more than 10 per cent greater than the output of the six New England States. The increases during the last five years compared very favorably with the increases in other sections of the country. There is less water-power in the Middle West section than in

TABLE II—CENTRAL-STATION STATISTICS OF THE CONTINENTAL UNITED STATES FOR 1912

State	Population in 1910	Number of Stations	Total Rating in Kw	Steam, Hp	Water, Hp	Total Output in Kw-hr.	Aggregate Income
Alabama	2,138,093	69	24,477	24,593	9,880	48,602,553	$1,210,156
Arizona	204,354	16	14,756	12,775	9,300	32,960,084	1,172,232
Arkansas	1,574,449	74	16,335	22,820	3,040	17,786,660	967,529
California	2,377,549	112	588,281	416,186	432,062	1,747,459,041	27,685,573
Colorado	799,024	73	71,668	56,999	77,005	165,196,068	4,771,074
Connecticut	1,114,756	44	77,655	90,257	19,434	130,672,201	5,345,640
*Delaware	202,322	*	*	*	*	*	*
*District of Columbia	331,069	*	*	*	*	*	*
Florida	752,619	50	23,619	28,136	5,700	25,895,751	1,323,899
Georgia	2,609,121	126	56,232	35,994	51,957	87,571,815	1,763,977
Idaho	325,594	38	35,656	4,525	51,850	115,812,292	1,587,407
Illinois	5,638,591	269	449,917	608,269	37,362	1,150,900,306	29,016,652
Indiana	2,700,876	201	135,801	161,588	23,915	236,944,000	7,711,223
Iowa	2,224,771	223	53,237	70,102	7,029	67,166,647	4,344,786
Kansas	1,690,949	176	69,205	89,508	8,820	133,252,988	2,922,935
Kentucky	2,289,905	89	54,062	81,767	.....	75,593,179	2,754,115
Louisiana	1,656,388	50	19,169	27,165	.....	18,328,080	2,246,129
Maine	742,371	79	58,757	19,745	69,938	117,092,565	2,044,280
*Maryland	1,294,450	*56	*87,137	*109,029	*4,049	*37,994,885	*5,189,469
Massachusetts	3,366,416	117	252,732	326,300	24,480	386,254,294	16,111,496
Michigan	2,810,173	235	247,789	252,103	125,079	525,615,508	11,518,256
Minnesota	2,075,708	195	93,502	67,939	80,172	186,045,055	6,937,841
Mississippi	1,797,114	82	21,863	30,497	.....	27,924,183	1,122,890
Missouri	3,293,335	190	122,786	180,193	1,902	232,828,763	9,746,600
Montana	376,053	29	74,398	12,825	102,885	379,212,617	3,883,410
Nebraska	1,192,214	174	34,586	46,284	5,884	56,299,682	2,802,614
Nevada	81,875	8	10,513	2,880	12,540	44,969,772	618,942
New Hampshire	430,572	59	57,768	27,291	56,937	126,593,970	2,326,998
New Jersey	2,537,167	64	179,477	237,945	1,569	383,891,504	10,901,484
New Mexico	327,396	21	7,981	10,198	817	9,027,824	495,658
New York	9,113,614	321	772,030	645,403	512,406	2,175,048,634	57,218,973
North Carolina	2,206,287	94	43,099	15,032	49,951	70,552,737	1,342,302
North Dakota	577,056	42	10,824	16,169	.....	12,298,553	860,536
Ohio	4,767,121	304	244,182	328,412	8,860	399,101,309	11,905,111
Oklahoma	1,657,155	130	28,301	51,787	2,135	48,824,097	2,239,709
Oregon	672,765	66	32,416	16,213	29,802	58,789,342	1,406,144
Pennsylvania	7,665,111	284	427,304	481,991	132,293	589,665,167	24,387,863
Rhode Ilsand	542,674	8	38,509	48,059	2,440	62,106,528	2,305,176
South Carolina	1,515,400	61	132,408	39,941	178,555	356,771,757	4,449,583
South Dakota	583,888	77	20,032	20,835	6,913	24,703,754	1,134,217
Tennessee	2,184,789	90	49,640	41,244	27,750	75,544,893	2,448,218
Texas	3,896,542	253	84,564	123,113	3,503	200,457,319	6,783,972
Utah	373,351	45	37,935	1,000	59,588	86,634,658	1,516,410
Vermont	355,956	61	29,468	15,091	35,272	56,552,977	1,173,851
Virginia	2,061,612	67	40,512	15,305	44,280	28,724,684	760,688
Washington	1,141,990	70	57,283	18,293	77,591	71,414,473	3,087,721
West Virginia	1,221,119	58	29,772	37,149	6,036	42,344,796	1,110,462
Wisconsin	2,333,860	251	98,839	76,645	68,766	215,402,974	6,274,589
Wyoming	145,965	20	8,212	10,262	1,334	11,580,567	605,462
Total	91,971,529	5,221	5,124,689	5,055,857	2,471,081	11,154,411,507	$299,534,252

*Delaware, District of Columbia and Maryland have been combined under Maryland, no separate figures being available.

any other section of the country, yet the percentage increase in output during the last five years and during the last decade was greater than that for similar periods in the North Central States. The output for Illinois, however, was greater than the output of the whole Middle West. The income per unit generated, on the other hand, was larger in the Middle West division than that of any other section of the country. Missouri, as was to be expected, made the best showing, with Texas second.

Rocky Mountain States

The figures of the central electric light and power stations of the Rocky Mountain States include those of Idaho, Montana, Wyoming, Nevada, Utah, Colorado, Arizona and New Mexico. The kilowatt output in the district shows phenomenal increases, notably in Idaho and Montana. As in other sections of the country, there is a sharp decline shown in the use of arc lamps within the five-year period. Utah shows a decrease

TABLE III—CENTRAL-STATION STATISTICS OF THE MANUFACTURING OR NORTH CENTRAL STATES

	1912	1907	1902	Per Cent Increase 1907–12	Per Cent Increase 1902–12
Number of establishments	2,043	2,098	1,794	2.6	13.9
Commercial	1,448	1,527	1,368	—5.1	5.8
Municipal	595	571	426	4.2	39.6
Income	$165,234,082	$96,797,890	$48,992,104	71.3	237.0
Light, heat and power	$155,774,016	$93,509,483	$48,289,437	66.6	221.0
All other sources	$9,460,066	$3,288,407	$702,667	188.0	1205.0
Total expenses, including salaries and wages	$130,188,800	$73,361,160	$40,072,381	78.2	225.0
Total number persons employed	44,871	25,587	17,268	74.5	159.5
Total horse-power	3,858,869	2,063,847	993,813	87.3	288.3
Steam and gas engines (including turbines):					
Number	4,059	3,883	3,325	4.3	22.4
Horse-power	2,938,534	1,553,163	812,427	89.0	262.0
Waterwheels:					
Number	1,242	1,105	582	12.4	113.6
Horse-power	920,335	480,726	173,361	91.7	432.0
Kw rating of generators	2,672,248	1,402,582	658,953	90.5	308.0
Output of stations, kw-hr.	4,756,909,083	3,188,521,028	1,548,057,312	49.2	207.0
Lamps wired for service:					
Arc	330,236	356,463	243,847	—7.3	36.7
All other varieties	42,736,177	23,494,752	10,889,180	82.4	292.0
Stationary motors served:					
Number	253,817	90,316	54,760	180.5	363.5
Horse-power	2,112,554	888,866	235,597	137.0	800.0

of 77 per cent in the number of arcs wired for service during the decade and an increase of 63.2 per cent in all other varieties. Colorado shows an increase in the number of incandescent and other lamps of 249.4 per cent during the decade. The development of water-power in the section is reflected in the increase of 440 per cent during the decade, whereas steam and gas engines increased only 163 per cent during the same decade. The growth in the use of electric motors, which showed an increase of 1025 per cent during the decade, is remarkable.

Pacific Coast States

The three states on the Pacific seaboard show remarkable increases, although the census figures for Washington call for some explanation.

The decreases shown in 1912 as compared with 1907 are due to the fact that the report for electric railways in 1912 includes a number of the important companies that in 1907 were reported as central electric stations. By combining the totals for several of the items of physical equipment for the central electric stations and the electric railways, a more correct idea may be had of the electrical industry in Washington, which increased since 1907 as follows: Primary power, from 109,661 hp in 1907 to 341,701 hp in 1912; the kilowatt rating of the dynamos, from 94,987 in 1907 to 209,913 in 1912, and the output of stations, from 283,302,190 kw-hr. in 1907 to 510,822,535 kw-hr. in 1912.

California is the second state in the Union in kilowatt rating of stations, in water-power and in kilowatt-hour output. She is the third state in the Union in

TABLE IV—CENTRAL-STATION STATISTICS OF MIDDLE WEST OR AGRICULTURAL STATES

	1912	1907	1902	Per Cent Increase 1907–12	Per Cent Increase 1902–12
Number of establishments	1,584	1,195	818	33	94
Commercial	1,063	864	604	23	76
Municipal	521	331	214	57	144
Income	$40,986,868	$23,315,027	$11,207,726	76	266
Light, heat and power	$39,229,192	$22,461,370	$10,984,721	75	257
All other sources	$1,757,676	$853,657	$223,005	106	688
Total expenses, including salaries and wages	$32,105,834	$19,423,441	$8,569,274	65	274
Total number persons employed	13,703	7,481	4,417	83	211
Total horse-power	835,313	513,417	215,717	63	287
Steam and gas engines (including turbines):					
Number	2,675	1,818	1,189	47	125
Horse-power	715,915	411,537	198,405	74	261
Waterwheels:					
Number	259	453	102	—43	154
Horse-power	109,502	94,473	14,569	16	652
Kw rating of generators	552,541	334,162	142,877	65	287
Output of stations, kw-hr.	997,991,598	524,936,290	250,118,674	90	300
Lamps wired for service:					
Arc	60,505	72,597	47,014	—17	29
All other varieties	11,614,358	6,173,143	2,343,394	88	395
Stationary motors served:					
Number	62,877	26,247	20,400	139	208
Horse-power	419,878	180,534	44,355	132	846

aggregate income and the twelfth state in the Union as regards population.

The census figures reveal the fact that electricity is cheaper on the Pacific Coast than anywhere else in the country. The three states on the Coast turned out more electricity than the twenty states in the Middle West and Southeastern sections combined. There was an in-

TABLE V—CENTRAL-STATION STATISTICS OF SOUTHEASTERN STATES

	1912	1907	1902	Per Cent Increase 1907–12	Per Cent Increase 1902–12
Number of establishments	728	576	348	21	120
Commercial	415	328	236	26	70
Municipal	313	248	112	26	180
Income	$17,175,828	$8,260,275	$4,044,875	110	320
Light, heat and power	$16,613,376	$8,035,526	$3,955,950	110	320
All other sources	$562,452	$226,848	$88,925	105	535
Total expenses, including salaries and wages	$13,029,782	$6,217,520	$2,974,686	110	335
Total number persons employed	5,055	2,968	1,827	70	175
Total horse-power	680,582	301,131	107,656	125	530
Steam and gas engines (including turbines):					
Number	1,024	776	499	32	105
Horse-power	312,509	158,590	86,648	97	261
Waterwheels:					
Number	298	194	50	54	496
Horse-power	368,073	139,525	20,326	164	1710
Kw rating of generators	445,912	194,686	73,004	129	510
Output of stations, kw-hr.	797,181,552	281,785,628	125,385,552	183	536
Lamps wired for service:					
Arc	29,139	28,364	17,708	3	65
All other varieties	4,002,485	1,873,954	713,614	114	447
Stationary motors served:					
Number	18,758	5,124	4,886	266	284
Horse-power	323,640	79,741	17,841	306	1710

crease in the horse-power of motors for the decade of over 1000 per cent.

Remarkable as the showing made by the Pacific Coast States is, it must be remembered that coal is very expensive there and cheap oil is available only in certain sections. As is well known, abundant water-power prevails near the Pacific seaboard, and the greatest electric transmission systems of the world are situated there.

TABLE VI—CENTRAL-STATION STATISTICS OF ROCKY MOUNTAIN STATES

	1912	1907	1902	Per Cent Increase 1907–1912	Per Cent Increase 1902–1912
Number of establishments	250	219	152	14.0	64.0
Commercial	211	199	147	6.0	44.0
Municipal	39	20	5	95.0	680.0
Income	$14,650,595	$8,816,227	$4,217,173	66.0	248.0
Light, heat and power	$13,763,088	$8,504,933	$4,127,455	62.0	233.0
All other sources	$887,507	$311,294	$89,718	185.0	889.0
Total expenses, including salaries and wages	$11,400,235	$6,361,801	$3,441,299	79.0	231.0
Total number persons employed	3,841	2,028	1,320	90.0	191.0
Total horse-power	426,783	225,287	105,338	90.0	305.0
Steam and gas engines (including turbines):					
Number	288	272	228	6.0	26.0
Horse-power	115,989	86,558	44,159	34.0	163.0
Waterwheels:					
Number	294	216	141	36.0	109.0
Horse-power	315,319	137,018	60,679	130.0	420.0
Kw rating of generators	261,119	151,032	65,952	73.0	296.0
Output of stations, kw-hr	845,393,882	381,032,187	145,780,112	122.0	480.0
Lamps wired for service:					
Arc	9,926	11,850	9,348	—16.0	6.0
All other varieties	2,239,337	1,321,876	612,258	69.0	266.0
Stationary motors served:					
Number	11,864	6,091	2,394	95.0	396.0
Horse-power	235,506	94,960	20,953	148.0	1025.

TABLE VII—CENTRAL-STATION STATISTICS OF THE PACIFIC COAST STATES

	1912	1907	1902	Per Cent Increase 1907–12	Per Cent Increase 1902–12
Number of establishments	248	261	194	—5	28
Commercial	211	230	171	—8	23
Municipal	37	31	23	19	60
Income	$32,179,438	$19,792,316	$6,541,650	63	390
Light, heat and power	$30,801,677	$18,981,997	$6,324,404	62	390
All other sources	$1,377,761	$810,319	$217,246	70	490
Total expenses, including salaries and wages	$26,279,396	$16,253,125	$5,070,102	62	420
Total number persons employed	7,348	4,480	1,821	64	320
Total horse-power	990,147	578,712	175,480	171	460
Steam and gas engines (including turbines):					
Number	301	286	231	5	23
Horse-power	450,692	184,907	56,979	144	657
Waterwheels:					
Number	329	292	220	13	50
Horse-power	539,455	366,614	107,366	47	402
Kw rating of generators	677,980	337,375	108,660	101	524
Output of stations, kw-hr	1,877,662,856	1,012,199,537	189,981,964	86	889
Lamps wired for service:					
Arc	30,904	30,389	20,764	2	49
All other varieties	7,956,640	4,065,923	1,210,363	96	557
Stationary motors served:					
Number	32,865	15,565	5,888	111	459
Horse-power	647,733	250,205	57,096	159	1035

TABLE VIII—CENSUS RETURNS OF NORTH CENTRAL OR MANUFACTURING STATES BY INDIVIDUAL STATES

	New York			New Jersey			Delaware, District of Columbia and Maryland		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of establishments	321	314	256	64	64	64	56	50	42
Commercial	272	267	228	56	57	60	43	36	31
Municipal	49	47	28	8	7	4	13	14	11
Income	$57,218,973	$34,859,170	$16,854,839	$10,901,484	$5,952,378	$3,421,304	$5,189,469	$3,347,728	$1,712,048
Light, heat and power	$53,189,000	$34,067,383	$16,742,239	$10,544,630	$5,910,745	$3,356,599	$5,105,399	$3,298,747	$1,693,396
All other sources	$4,029,973	$791,787	$112,600	$356,854	$41,633	$64,705	$84,070	$48,981	$18,652
Total expenses, including salaries and wages	$44,297,869	$25,961,930	$14,706,366	$9,348,864	$4,599,586	$3,413,914	$4,056,055	$3,819,147	$1,446,850
Total number of persons employed	13,733	7,716	5,421	2,989	1,759	1,074	1,249	1,024	549
Total horse-power	1,157,809	722,653	323,413	239,514	93,602	68,761	113,078	85,346	29,863
Steam and gas engines (including turbines):									
Number	619	541	501	272	205	177	117	130	120
Horse-power	645,403	413,322	192,291	237,945	90,273	66,916	109,029	82,346	29,588
Waterwheels:									
Number	405	362	241	18	22	14	33	18	6
Horse-power	512,406	305,950	128,785	1,569	1,794	1,005	4,049	1,632	275
Kilowatt rating of dynamos	772,030	482,031	187,252	179,477	70,566	46,120	87,137	62,956	21,639
Output of stations, kilowatt-hours	2,175,048,634	1,452,222,471	701,769,716	383,891,504	140,527,522	78,739,456	37,994,885	78,412,197	39,999,997
Estimated number of lamps wired for service:									
Arc	94,324	97,529	59,130	22,585	21,973	15,685	8,144	13,765	8,905
All other varieties	12,884,911	7,017,061	3,705,525	2,961,343	1,675,024	646,762	1,727,106	1,055,779	282,758
Stationary motors served:									
Number	82,525	18,051	13,581	12,772	5,994	2,213	13,718	6,523	1,429
Horse-power	795,256	393,955	109,277	85,011	27,604	9,246	76,527	32,856	5,919

TABLE VIII—(CONTINUED)

	Pennsylvania			West Virginia			Ohio		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of establishments	284	327	279	58	48	41	304	272	233
Commercial	239	282	243	52	43	35	186	167	145
Municipal	45	45	36	6	5	6	118	105	88
Income	$24,387,863	$16,015,392	$9,486,867	$1,110,462	$724,253	$322,015	$11,905,111	$7,643,997	$4,431,038
Light, heat and power	$23,482,208	$15,400,800	$9,311,416	$1,090,968	$689,919	$320,443	$11,514,628	$7,474,980	$4,347,506
All other sources	$905,655	$614,592	$175,451	$19,494	$34,334	$1,572	$390,483	$169,017	$83,532
Total expenses, including salaries and wages	$18,174,684	$12,155,341	$7,547,967	$897,843	$534,365	$229,558	$8,722,293	$6,027,780	$3,286,336
Total number of persons employed	7,328	4,502	3,180	439	262	178	3,131	2,157	1,766
Total horse-power	614,284	302,537	175,510	43,185	21,428	10,820	337,272	179,111	103,745
Steam and gas engines (including turbines):									
Number	696	771	689	112	79	66	599	533	450
Horse-power	481,991	265,632	167,083	37,149	17,416	10,720	328,412	175,879	101,279
Waterwheels:									
Number	136	119	50	14	11	1	33	21	14
Horse-power	132,293	30,863	6,988	6,036	3,627	100	8,860	2,037	1,676
Kilowatt rating of dynamos	427,304	212,543	121,388	29,772	14,726	6,985	244,182	126,533	69,811
Output of stations, kilowatt-hours	589,665,167	416,554,167	241,094,328	42,344,796	24,871,317	11,355,905	399,101,309	217,311,924	127,437,383
Estimated number of lamps wired for service:									
Arc	64,673	66,777	47,722	2,468	2,885	1,898	36,318	43,849	31,839
All other varieties	6,257,665	3,897,662	1,783,683	305,312	160,279	78,066	3,454,515	2,267,958	934,213
Stationary motors served:									
Number	29,119	10,063	14,144	1,279	340	136	29,022	13,083	5,704
Horse-power	333,414	122,461	30,560	22,925	4,432	291	145,331	64,941	21,956

TABLE VIII—(CONTINUED)

	INDIANA			MICHIGAN			ILLINOIS		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of establishments	201	200	180	235	234	201	269	383	346
Commercial	130	132	118	127	130	120	170	271	264
Municipal	71	68	62	108	104	81	99	112	82
Income	$7,711,223	$4,438,832	$2,105,146	$11,518,256	$6,072,010	$2,613,812	$29,016,652	$15,465,993	$6,757,015
Light, heat and power	$7,417,484	$4,222,610	$2,038,121	$11,127,031	$5,750,447	$2,516,800	$26,317,474	$14,566,772	$6,692,248
All other sources	$293,739	$215,722	$67,025	$391,225	$321,563	$97,012	$2,669,178	$899,221	$64,767
Total expenses, including salaries and wages	$6,028,909	$3,627,336	$1,573,908	$9,784,138	$4,611,070	$1,948,546	$23,557,887	$10,055,463	$4,961,915
Total number of persons employed	2,169	1,618	941	3,876	1,780	1,255	8,036	3,902	2,339
Total horse-power	185,503	116,828	54,237	377,182	184,207	64,883	645,631	299,246	126,866
Steam and gas engines (including turbines):									
Number	369	364	289	346	308	268	611	700	571
Horse-power	161,588	95,467	53,002	252,103	97,711	47,591	608,269	287,828	116,969
Waterwheels:									
Number	90	83	12	245	249	114	92	80	52
Horse-power	23,915	19,606	1,105	125,079	85,738	16,085	37,362	10,478	9,505
Kilowatt rating of dynamos	135,801	81,576	38,144	247,789	101,714	44,176	449,917	209,226	100,320
Output of stations, kilowatt-hours	236,944,000	130,263,693	75,585,493	525,615,508	208,154,199	80,564,630	1,150,900,305	467,657,328	161,543,646
Estimated number of lamps wired for service:									
Arc	17,328	22,165	15,325	20,516	23,514	17,712	53,486	55,309	38,215
All other varieties	2,375,448	1,330,660	653,451	3,602,606	1,717,339	805,127	7,375,539	3,591,309	1,567,665
Stationary motors served:									
Number	14,005	5,132	2,631	18,400	7,089	2,271	46,278	21,675	11,838
Horse-power	91,897	33,716	5,653	174,009	53,245	11,337	315,659	137,661	35,928

TABLE IX—CENSUS RETURNS OF MIDDLE WEST OR AGRICULTURAL STATES BY INDIVIDUAL STATES

	WISCONSIN*			MINNESOTA			IOWA		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of establishments	251	206	152	195	171	138	223	192	169
Commercial	173	142	124	91	79	68	159	141	131
Municipal	78	64	28	104	92	70	64	51	38
Income	$6,274,589	$2,278,637	$1,288,020	$6,937,841	$3,478,009	$1,858,789	$4,344,786	$2,479,969	$1,545,663
Light, heat and power	$5,955,194	$2,127,080	$1,270,669	$6,647,199	$3,333,469	$1,838,806	$4,017,588	$2,317,880	$1,477,348
All other sources	$319,395	$151,557	$17,351	$290,642	$144,540	$19,983	$327,198	$162,089	$68,315
Total expenses, including salaries and wages	$5,320,258	$1,969,142	$957,021	$5,580,525	$2,986,277	$1,459,874	$3,328,740	$1,983,613	$1,223,682
Total number of persons employed	1,921	867	565	1,568	1,052	619	1,329	855	732
Total horse-power	145,411	58,889	35,715	148,111	121,825	34,823	77,131	46,739	39,504
Steam and gas engines (including turbines):									
Number	318	252	194	301	250	197	360	279	242
Horse-power	76,645	39,262	26,988	67,939	49,523	28,562	70,102	42,470	36,990
Waterwheels:									
Number	176	140	78	76	71	27	58	44	31
Horse-power	68,766	19,001	7,837	80,172	71,656	6,000	7,029	3,833	2,399
Kilowatt rating of dynamos	98,839	40,711	23,118	93,502	78,516	20,999	53,237	32,056	24,886
Output of stations, kilowatt-hours	215,402,974	52,546,210	29,966,758	186,045,055	87,579,431	40,258,632	67,166,647	37,729,072	36,506,425
Estimated number of lamps wired for service:									
Arc	10,394	8,697	7,416	9,201	13,398	8,543	4,679	7,352	5,929
All other varieties	1,791,732	781,681	428,930	1,858,306	903,023	384,705	1,512,568	809,386	420,847
Stationary motors served:									
Number	6,699	2,366	813	12,203	3,711	1,855	8,773	2,643	1,054
Horse-power	72,525	17,995	5,430	75,973	41,095	9,481	43,820	14,547	4,193

TABLE IX—(CONTINUED)

	NORTH DAKOTA			SOUTH DAKOTA			NEBRASKA		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of establishments	42	29	21	77	37	28	174	98	54
Commercial	33	21	13	64	29	22	112	73	43
Municipal	9	8	8	13	8	6	62	25	11
Income	$860,536	$533,383	$197,689	$1,134,217	$513,682	$207,868	$2,802,614	$1,562,669	$601,777
Light, heat and power	$822,929	$480,012	$197,375	$1,037,017	$492,767	$201,292	$2,589,960	$1,474,426	$597,304
All other sources	$37,607	$53,341	$314	$66,600	$20,915	$3,576	$124,374	$88,243	$4,473
Total expenses, including salaries and wages	$714,294	$413,506	$157,275	$965,763	$433,841	$157,971	$2,239,542	$1,158,060	$431,342
Total number of persons employed	232	150	75	338	169	85	882	404	237
Total horse-power	16,169	10,277	3,930	27,748	12,984	5,057	52,168	30,020	12,308
Steam and gas engines (including turbines):									
Number	82	57	30	136	55	34	247	132	67
Horse-power	16,169	10,025	3,830	20,835	10,580	4,062	46,284	26,091	10,488
Waterwheels:									
Number	.....	1	1	15	12	7	44	19	9
Horse-power	.....	100	100	6,913	2,205	845	5,884	2,954	1,820
Kilowatt rating of dynamos	10,824	5,819	2,042	20,032	10,046	2,910	31,586	20,011	8,412
Output of stations, kilowatt-hours	12,298,553	8,229,765	5,850,115	24,703,754	13,615,015	4,256,007	56,299,682	31,958,739	12,315,775
Estimated number of lamps wired for service:									
Arc	866	1,163	502	1,134	1,278	798	3,682	4,262	2,608
All other varieties	219,452	119,233	41,916	278,221	129,643	63,248	1,034,661	490,101	151,162
Stationary motors served:									
Number	1,145	327	81	1,394	279	43	3,575	1,719	604
Horse-power	6,128	1,816	703	13,619	3,649	239	26,325	10,776	2,278

*Wisconsin is placed here merely for convenience of make-up. It is included in group of North Central States.

TABLE IX—(CONTINUED)

	MISSOURI			KANSAS			ARKANSAS		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of establishments	190	162	123	176	111	61	74	63	42
Commercial	125	104	80	94	79	50	56	50	34
Municipal	65	58	43	82	32	11	18	13	8
Income	$9,746,600	$5,805,828	$2,392,149	$2,922,935	$1,514,867	$650,833	$967,529	$675,718	$425,317
Light, heat and power	$9,299,495	$5,683,795	$2,360,150	$2,811,793	$1,419,091	$611,966	$930,430	$664,916	$413,775
All other sources	$447,105	$122,033	$31,999	$111,142	$95,776	$38,867	$37,099	$10,802	$11,542
Total expenses, including salaries and wages	$7,484,853	$5,341,126	$2,042,422	$2,626,270	$1,201,101	$480,482	$749,029	$491,871	$278,817
Total number of persons employed	2,434	1,800	997	1,109	567	292	360	244	149
Total horse-power	182,095	111,416	45,318	98,328	48,374	13,283	25,860	13,953	8,433
Steam and gas engines (including turbines):									
Number	323	249	189	295	167	83	120	92	63
Horse-power	180,193	103,037	43,309	89,508	38,767	12,224	22,820	13,328	8,206
Waterwheels:									
Number	5	5	2	26	36	11	10	1	2
Horse-power	1,902	2,002	1,000	8,820	8,661	1,034	3,010	300	227
Kilowatt rating of dynamos	122,786	68,467	32,100	69,205	30,307	8,596	16,335	9,678	6,024
Output of stations, kilowatt-hours	232,828,763	147,328,446	57,450,731	133,252,988	59,740,179	13,326,518	17,786,660	11,519,316	9,965,997
Estimated number of lamps wired for service:									
Arc	13,394	17,576	13,144	7,901	5,685	3,498	1,102	1,669	1,654
All other varieties	2,526,515	1,705,396	593,798	898,201	472,751	128,857	243,728	142,525	82,234
Stationary motors served:									
Number	15,429	8,923	4,646	5,021	1,425	1,484	994	198	838
Horse-power	116,971	54,111	14,552	33,277	12,033	1,885	5,283	1,177	722

TABLE IX—(CONTINUED)

	OKLAHOMA			LOUISIANA			TEXAS		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of establishments	130	72	20	50	42	25	253	218	137
Commercial	67	58	18	27	21	15	235	209	130
Municipal	63	14	2	23	21	10	18	9	7
Income	$2,239,709	$1,106,316	$281,452	$2,246,129	$1,852,383	$971,631	$6,783,972	$3,792,203	$2,074,558
Light, heat and power	$2,169,088	$1,097,134	$267,453	$2,218,477	$1,829,128	$967,027	$6,654,616	$3,668,722	$2,019,225
All other sources	$70,621	$9,182	$13,999	$27,652	$23,255	$4,604	$129,356	$123,481	$25,333
Total expenses, including salaries and wages	$1,888,703	$1,025,702	$176,539	$1,604,019	$1,291,908	$682,939	$4,924,093	$3,096,436	$1,477,931
Total number of persons employed	785	414	92	489	541	336	2,021	1,275	773
Total horse-power	53,922	22,623	4,407	27,165	23,292	13,767	126,616	71,914	34,887
Steam and gas engines (including turbines):									
Number	232	112	28	95	74	48	484	351	208
Horse-power	51,787	22,549	4,407	27,165	22,787	13,567	123,113	67,410	32,768
Waterwheels:									
Number	7	.....	.....	.....	.....	.....	18	23	12
Horse-power	2,135	.....	.....	.....	.....	.....	3,503	2,762	1,104
Kilowatt rating of dynamos	28,301	15,499	3,019	19,169	15,175	7,781	84,564	48,558	26,108
Output of stations, kilowatt-hours	48,824,097	24,985,903	3,825,763	18,328,080	26,421,316	17,474,261	200,457,319	75,829,108	48,888,450
Estimated number of lamps wired for service:									
Arc	3,659	3,451	914	7,267	8,587	4,278	7,617	8,176	5,146
All other varieties	592,315	219,537	37,443	584,015	377,225	135,593	1,866,373	804,323	303,591
Stationary motors served:									
Number	3,470	1,086	430	2,428	1,713	1,129	8,445	4,223	8,236
Horse-power	23,056	6,586	347	24,557	16,110	5,128	50,869	18,634	4,827

TABLE X—CENSUS RETURNS OF PACIFIC COAST STATES BY INDIVIDUAL STATES

	WASHINGTON			OREGON			CALIFORNIA		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of establishments	70	71	40	66	61	39	112	129	115
Commercial	60	65	33	54	50	33	97	115	105
Municipal	10	6	7	12	11	6	15	14	10
Income	$3,087,721	$3,410,542	$783,651	$1,406,144	$1,965,245	$691,582	$27,685,573	$14,416,529	$5,066,417
Light, heat and power	$2,976,297	$3,219,814	$739,743	$1,364,226	$1,840,155	$638,571	$26,461,154	$13,922,028	$4,946,090
All other sources	$111,424	$190,728	$43,908	$41,918	$125,090	$53,011	$1,224,419	$494,501	$120,327
Total expenses, including salaries and wages	$2,270,132	$2,388,628	$651,495	$1,205,738	$1,283,560	$499,632	$22,803,526	$12,580,937	$3,918,975
Total number of persons employed	1,078	885	274	532	467	187	5,738	3,128	1,360
Total horse-power	95,884	67,224	22,894	46,015	126,815	17,798	848,248	384,673	134,788
Steam and gas engines (including turbines):									
Number	58	54	38	63	65	37	180	167	156
Horse-power	18,293	10,764	5,553	16,213	24,259	6,583	416,186	149,884	54,843
Waterwheels:									
Number	64	48	41	60	72	46	205	172	133
Horse-power	77,591	56,118	17,238	29,802	102,052	11,195	432,062	208,444	78,933
Kilowatt rating of dynamos	57,283	66,308	13,679	32,416	32,587	11,165	588,281	238,480	83,816
Output of stations, kilowatt-hours	71,414,473	257,785,236	19,722,262	58,789,342	92,807,992	17,531,660	1,747,459,041	661,606,309	152,728,042
Estimated number of lamps wired for service:									
Arc	4,729	6,771	2,977	1,285	3,927	2,023	24,890	19,691	15,764
All other varieties	781,244	624,865	108,443	382,196	372,844	95,045	6,793,200	3,068,214	1,006,875
Stationary motors served:									
Number	2,279	1,933	295	1,527	2,072	403	29,059	11,560	5,190
Horse-power	28,148	29,686	2,780	15,843	20,452	4,020	603,742	200,067	50,296

TABLE XI—CENSUS RETURNS OF SOUTHEASTERN STATES BY INDIVIDUAL STATES

	VIRGINIA			NORTH CAROLINA			SOUTH CAROLINA		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of establishments	67	51	37	94	71	38	61	40	24
Commercial	53	37	27	46	35	22	39	23	16
Municipal	14	14	10	48	36	16	22	17	8
Income	$760,688	$390,628	$210,632	$1,342,302	$543,322	$250,133	$4,449,583	$901,537	$387,010
Light, heat and power	$750,524	$380,779	$210,176	$1,287,683	$527,672	$241,903	$4,215,766	$865,708	$356,066
All other sources	$10,164	$9,849	$456	$54,619	$15,650	$8,230	$233,817	$35,829	$30,944
Total expenses, including salaries and wages	$567,459	$261,795	$171,185	$1,046,217	$437,215	$192,775	$2,850,661	$634,375	$272,729
Total number of persons employed	341	178	170	453	248	141	683	261	160
Total horse-power	59,585	14,619	5,443	64,983	20,683	6,566	218,496	84,115	21,205
Steam and gas engines (including turbines):									
Number	69	39	40	92	73	42	71	49	36
Horse-power	15,305	4,928	4,177	15,032	10,241	4,630	39,941	8,625	10,690
Waterwheels:									
Number	63	44	10	52	32	10	88	52	9
Horse-power	44,280	9,551	1,221	49,951	9,962	1,920	178,555	75,430	10,415
Kilowatt rating of dynamos	40,512	9,195	3,827	43,099	13,911	4,141	132,408	51,271	13,390
Output of stations, kilowatt-hours	28,724,684	10,208,360	6,879,243	70,552,737	13,171,681	8,351,346	356,771,757	68,696,424	18,426,763
Estimated number of lamps wired for service:									
Arc	2,589	1,415	1,278	1,928	1,936	1,178	2,345	2,521	1,366
All other varieties	237,079	93,635	37,645	571,384	144,256	45,181	268,721	150,018	46,068
Stationary motors served:									
Number	753	268	450	1,876	249	161	5,452	969	160
Horse-power	8,570	3,690	257	32,830	4,345	950	155,385	37,388	6,546

TABLE XI—(CONTINUED)

	GEORGIA			FLORIDA			ALABAMA		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of establishments	126	93	43	50	37	26	69	55	25
Commercial	42	34	24	33	24	21	34	27	16
Municipal	84	59	19	17	13	5	35	28	9
Income	$1,763,077	$1,110,510	$357,565	$1,323,899	$654,251	$324,770	$1,210,156	$1,012,743	$385,263
Light, heat and power	$1,677,363	$1,086,601	$348,753	$1,301,479	$630,632	$323,414	$1,186,976	$997,506	$374,138
All other sources	$86,614	$23,909	$8,812	$22,420	$23,619	$1,356	$23,180	$15,237	$11,125
Total expenses, including salaries and wages	$1,655,420	$844,557	$254,838	$1,052,696	$480,726	$224,637	$980,169	$872,302	$284,537
Total number of persons employed	697	384	203	455	265	136	456	343	162
Total horse-power	87,951	54,704	12,630	33,836	14,370	6,114	34,473	26,404	7,620
Steam and gas engines (including turbines):									
Number	160	104	46	96	69	47	96	81	38
Horse-power	35,994	18,269	6,409	28,136	14,244	6,106	24,593	19,247	7,620
Waterwheels:									
Number	45	37	12	3	.....	.....	15	15	.....
Horse-power	51,957	36,335	6,121	5,700	.....	.....	9,880	7,007	.....
Kilowatt rating of dynamos	56,232	35,446	7,620	23,619	7,804	4,699	24,477	17,124	4,473
Output of stations, kilowatt-hours	87,571,815	59,311,202	9,911,243	25,895,751	11,765,994	8,066,078	48,602,553	30,846,764	11,616,707
Estimated number of lamps wired for service:									
Arc	2,651	3,173	1,452	1,264	1,408	1,106	3,920	4,926	2,033
All other varieties	410,968	180,337	60,139	367,772	141,284	61,144	347,871	232,646	61,373
Stationary motors served:									
Number	1,964	410	47	1,121	189	133	1,065	541	750
Horse-power	50,633	11,078	2,123	14,141	1,584	455	11,148	5,650	747

TABLE XI—(CONTINUED)

	MISSISSIPPI			TENNESSEE			KENTUCKY		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of establishments	82	68	43	90	78	54	89	83	58
Commercial	35	29	25	60	50	35	73	69	50
Municipal	47	39	18	30	28	19	16	14	8
Income	$1,122,890	$686,700	$366,934	$2,448,218	$1,299,983	$912,482	$2,754,115	$1,660,700	$850,086
Light, heat and power	$1,101,686	$667,543	$341,546	$2,408,762	$1,266,610	$911,555	$2,683,137	$1,610,475	$848,399
All other sources	$21,204	$19,157	$25,388	$39,456	$33,373	$927	$70,978	$50,225	$1,687
Total expenses, including salaries and wages	$878,379	$519,869	$277,719	$1,753,875	$882,763	$587,032	$2,244,906	$1,283,918	$709,231
Total number of persons employed	407	288	182	656	416	306	907	585	367
Total horse-power	30,497	15,522	7,660	68,994	28,730	19,003	81,767	41,984	21,415
Steam and gas engines (including turbines):									
Number	129	97	60	134	116	87	177	148	103
Horse-power	30,497	14,847	7,660	41,244	26,510	17,971	81,767	41,679	21,385
Waterwheels:									
Number	.....	.....	.....	32	14	8	.....	.....	1
Horse-power	.....	.....	.....	27,750	1,240	619	.....	.....	30
Kilowatt rating of dynamos	21,863	9,884	5,106	49,640	20,911	14,736	54,062	29,110	15,012
Output of stations, kilowatt-hours	27,924,183	15,704,624	9,825,926	75,544,893	34,847,956	24,472,632	75,593,179	37,232,623	27,835,614
Estimated number of lamps wired for service:									
Arc	1,823	1,694	1,035	4,808	4,407	3,662	7,814	6,884	4,598
All other varieties	279,220	141,079	85,111	671,150	306,903	174,291	849,220	483,796	142,662
Stationary motors served:									
Number	701	181	1,182	1,720	1,193	1,218	4,106	1,124	785
Horse-power	7,955	1,520	256	20,357	4,524	3,335	22,621	9,962	3,172

TABLE XII—CENSUS RETURNS OF ROCKY MOUNTAIN STATES BY INDIVIDUAL STATES

	IDAHO			MONTANA			WYOMING		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of establishments	38	42	19	29	33	27	20	18	13
Commercial	35	40	18	27	31	26	18	18	13
Municipal	3	2	1	2	2	1	2	.....	.....
Income	$1,587,407	$719,395	$192,206	$3,883,410	$2,469,131	$1,025,971	$605,462	$317,580	$159,216
Light, heat and power	$1,551,519	$692,489	$191,126	$3,292,385	$2,376,472	$1,017,805	$593,832	$303,683	$159,016
All other sources	$35,858	$26,906	$1,080	$591,025	$92,659	$8,166	$11,630	$13,897	$200
Total expenses, including salaries and wages	$1,537,260	$472,493	$141,160	$2,411,668	$1,469,808	$660,476	$445,789	$235,846	$111,582
Total number of persons employed	324	188	88	514	319	202	163	96	53
Total horse-power	56,375	13,694	5,454	115,710	68,817	31,887	11,596	5,125	3,229
Steam and gas engines (including turbines):									
Number	14	19	15	39	31	26	46	30	27
Horse-power	4,525	2,202	1,530	12,825	11,830	7,787	10,262	4,310	3,154
Waterwheels:									
Number	63	37	23	64	62	44	11	6	1
Horse-power	51,850	11,492	3,924	102,885	56,987	24,000	1,334	765	75
Kilowatt rating of dynamos	35,656	7,082	2,774	74,398	39,602	22,055	8,212	3,208	1,831
Output of stations, kilowatt-hours	115,812,292	9,577,588	5,018,149	379,212,617	137,379,261	36,435,766	11,580,567	5,499,084	3,883,285
Estimated number of lamps wired for service:									
Arc	1,349	966	557	2,193	3,123	1,648	492	517	259
All other varieties	261,096	122,491	33,262	388,718	231,201	101,868	112,228	59,674	22,082
Stationary motors served:									
Number	1,723	406	163	1,962	971	151	672	131	1
Horse-power	27,142	4,054	205	75,184	33,240	1,401	6,224	685	1

TABLE XII—(CONTINUED)

	NEVADA			UTAH			COLORADO		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of establishments	8	9	5	45	31	16	73	56	48
Commercial	7	9	5	28	22	15	62	49	46
Municipal	1	.....	.....	17	9	1	11	7	2
Income	$618,942	$372,108	$44,549	$1,516,410	$665,241	$714,353	$4,771,074	$3,410,240	$1,652,505
Light, heat and power	$607,597	$352,959	$44,549	$1,497,205	$627,332	$664,240	$4,606,427	$3,317,844	$1,628,953
All other sources	$11,345	$19,149	.....	$19,205	$37,909	$50,113	$164,647	$9 ,396	$23,552
Total expenses, including salaries and wages	$428,255	$245,291	$39,687	$1,206,729	$461,675	$607,769	$3,997,760	,785,401	$1,537,471
Total number of persons employed	147	78	18	401	198	240	1,917	918	588
Total horse-power	15,420	6,980	1,720	60,588	35,950	20,460	134,004	82,427	38,268
Steam and gas engines (including turbines):									
Number	14	9	4	6	10	9	95	114	99
Horse-power	2,880	695	250	1,000	1,279	2,030	56,999	5,301	25,118
Waterwheels:									
Number	13	9	4	63	43	26	67	47	42
Horse-power	12,540	6,260	1,470	59,588	34,671	18,410	77,005	25,580	12,750
Kilowatt rating of dynamos	10,513	5,690	764	37,935	33,592	13,923	71,668	53,130	21,808
Output of stations, kilowatt-hours	44,969,772	29,621,730	1,508,910	86,634,658	61,672,681	32,467,063	165,196,068	123,275,212	60,177,084
Estimated number of lamps wired for service:									
Arc	321	327	78	333	430	1,469	4,178	5,301	4,770
All other varieties	45,443	63,939	8,213	150,380	67,679	92,165	1,032,865	649,494	295,605
Stationary motors served:									
Number	303	411	13	1,044	406	295	4,780	3,232	1,264
Horse-power	12,384	6,850	180	37,490	5,519	5,868	60,451	41,161	12,484

TABLE XII—(CONTINUED)

	ARIZONA			NEW MEXICO		
	1912	1907	1902	1912	1907	1902
Number of establishments	16	15	13	21	15	11
Commercial	16	15	13	18	15	11
Municipal	.....	.....	.....	3	.....	.....
Income	$1,172,232	$569,850	$293,096	$495,658	$292,682	$135,307
Light, heat and power	$1,127,908	$544,192	$288,019	$486,185	$289,962	$133,747
All other sources	$44,324	$25,658	$5,047	$9,473	$2,720	$1,560
Total expenses, including salaries and wages	$923,258	$464,350	$240,953	$449,516	$226,937	$102,201
Total number of persons employed	217	148	86	158	83	45
Total horse-power	22,075	7,746	2,540	11,015	4,548	1,780
Steam and gas engines (including turbines):						
Number	33	33	27	41	26	21
Horse-power	12,775	6,906	2,540	10,198	1,035	1,730
Waterwheels:						
Number	4	4	.....	9	6	1
Horse-power	9,300	750	.....	817	513	50
Kilowatt rating of dynamos	14,756	4,939	1,811	7,981	3,780	986
Output of stations, kilowatt-hours	32,960,084	9,392,302	3,662,045	9,027,824	1,614,349	2,637,810
Estimated number of lamps wired for service:						
Arc	686	754	295	377	332	272
All other varieties	136,100	72,028	36,556	112,207	35,379	22,507
Stationary motors served:						
Number	741	339	132	639	195	75
Horse-power	12,547	2,220	714	4,084	1,231	100

Electrical Distribution Engineering in Chicago—II

Substation and battery equipment of the Commonwealth Edison Company—Care of cables and pole lines, methods of preventing electrolysis, and organization of substation department

IN the *Electrical World* of March 7 the operating methods of the Commonwealth Edison Company in reference to the organization of the staff, methods of new construction and the use of underground cable were described. A description of other features of operation follows.

Inspection and Repair of Cables and Pole Lines

No routine tests are made on the high-tension cables, as experience has shown that they cause more interference with service than they save. A force of men is constantly at work in manholes, cleaning them and testing the low-tension junction boxes and testing for open mains in the Edison-tube system. These men report the condition of cables as they incidentally observe them and so perform a function as inspectors. One regular inspector is employed, who devotes his attention principally to new work. There is so little trouble with high-tension cables that this very simple system gives excellent results.

The overhead lines are regularly patrolled, an inspector being assigned to each district for this purpose. The repair gangs at once correct defects reported by the inspectors. Trouble-men are always in readiness to be sent out on emergency calls in connection with overhead-line failures. When a circuit-breaker connected to a sixty-cycle line opens once a trouble man is sent out. This practice has been made a rule since the company decided to set protective relays for operation at a minimum of about 50 per cent overload, or for about double load for two seconds. These settings correspond to 240 amp and 340 amp respectively for a No. 0 cable. Thus the opening of a circuit-breaker indicates line trouble.

The substation switch equipment is also regularly inspected to prevent interruption to service by a force of repair men who are employed in cleaning and repairing insulators and switch gear. These men report to the substation department. Their work, however, has a vital relation to line maintenance.

In repairing high-tension lines every precaution is taken to insure the safety of linemen. This is especially necessary when there are so many substations interconnected with a network of cables and pole line. A special code of safety rules has been inaugurated and is strictly enforced. When work is to be done which will interfere with customers' service, or when changes in line connections are to be made, the overhead department makes requisition for a load dispatcher's permit which gives permission to do specified work between stated times of starting and completion. This is approved by the starting engineer and the load dispatcher. Copies of the permit go to the construction or cable foreman and to the station operator. The former re-

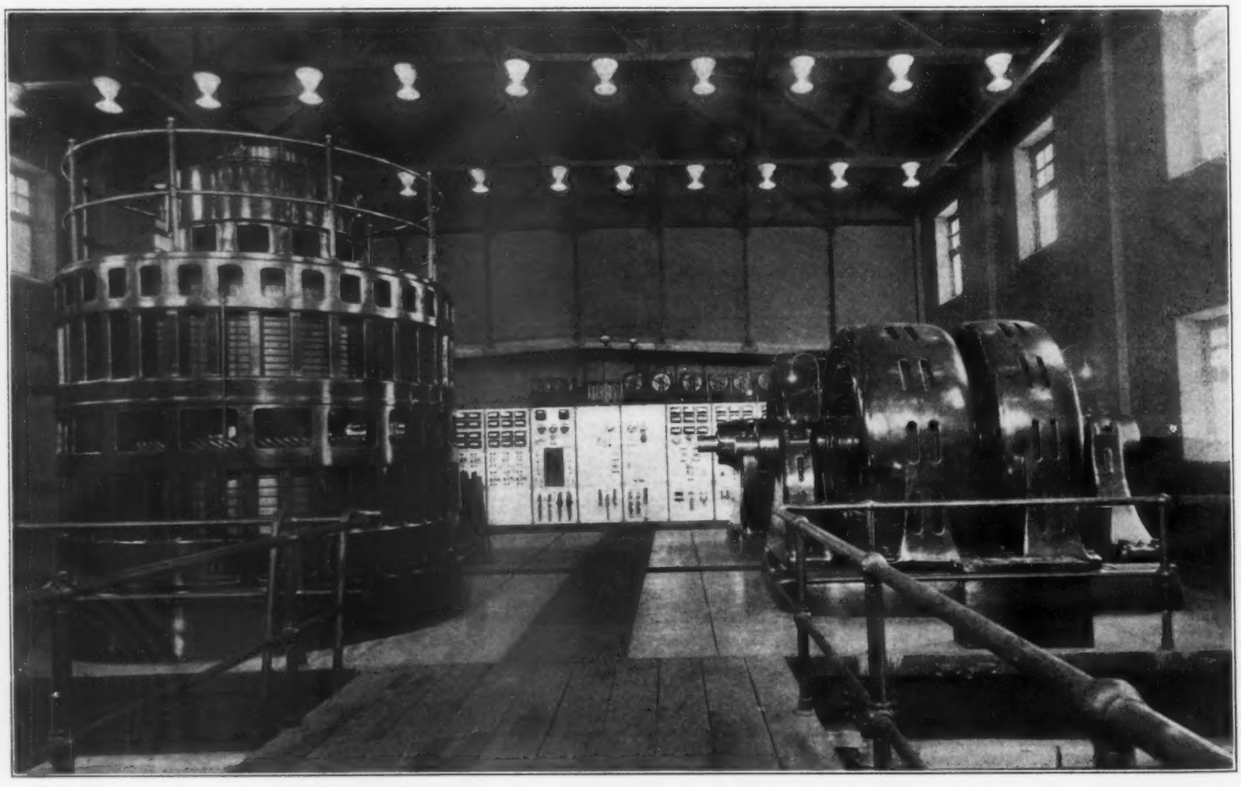


FIG. 10—FREQUENCY-CHANGER SETS IN HYDE PARK SUBSTATION

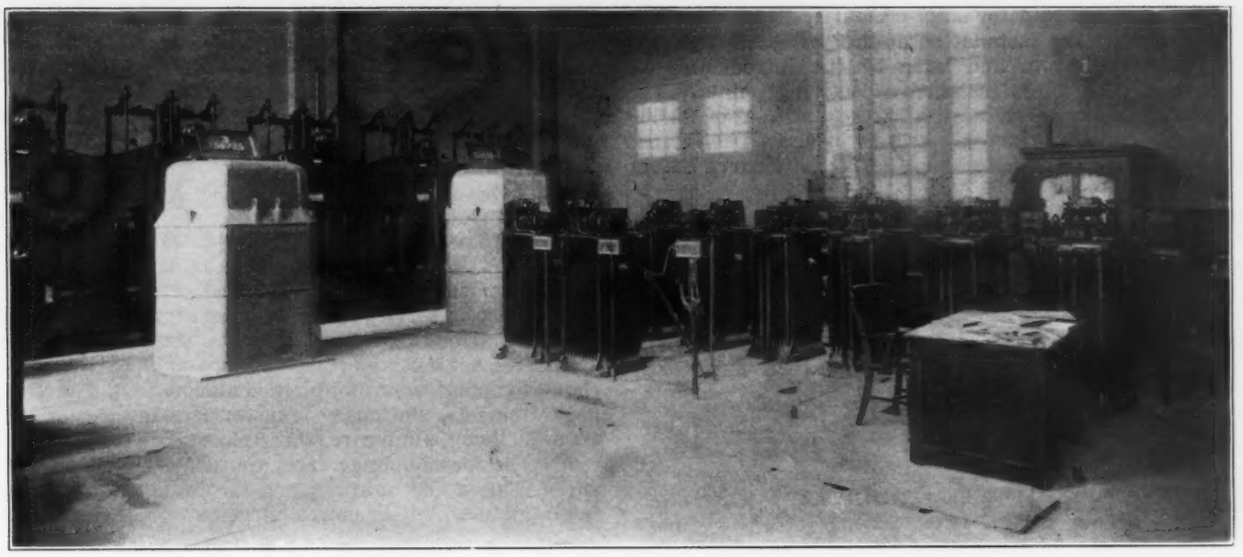


FIG. 11—AUTOMATIC REGULATORS AND OIL SWITCHES IN EDGEWATER SUBSTATION

ports to the operator in person and presents his permit, which is verified by consultation over the telephone with the load dispatcher. The operator has two days' notice of repairs so that he is prepared to spare the line. The load dispatcher then orders the line out of service and has it and the high-tension apparatus grounded in accordance with definite grounding rules. The load dispatcher orders the line put back into service after the necessary tests have been made.

Prevention of Electrolysis

With such a vast network of high-tension and low-tension underground circuits the prevention of electrolytic corrosion requires constant watchfulness. A force of men is therefore kept constantly at work. The whole system is covered monthly in routine inspection of polarity and potential of cable coverings. If dangerous differences of potential, 1 volt or more, are found between the sheath and surrounding conductors, remedial measures are taken. The latter are usually in the direction of "drainage" rather than in breaking up neighboring pipes into insulated sections.

The first steps in bonding were taken in 1895 and 1896, when the trolley lines began to extend into the downtown district and to make trouble for the lighting company. Bonding of cable sheaths to each other and to neighboring conductors was begun near the power plants and was extended out radially therefrom. At first bonds were put in about a quarter of a mile apart and at branching points. As substations were installed they introduced new danger centers and drainage cables connecting with negative busbars were added. Occasionally it has been necessary to parallel the cables with special drainage cables and the cables are sometimes bonded direct to the rails. Each problem is treated from the standpoint of economy. Practically all of the overhead structure of the elevated railways and the surface tracks are bonded together, greatly improving the return circuit. As new construction goes on in manholes the opportunity is taken to bond all cables together, so that the whole system is being rapidly bonded. The copper bonding wire has capacity as great as or greater than the lead coverings in order that it may not burn off in case of trouble. Incidentally it should be noted that this bonding minimizes the destructive effect of cable burn-outs by localizing the current flowing in the lead sheaths.

The result of all of this care is a reduction in expense chargeable to electrolysis to about one-third what it was a few years ago. Electrical repairs at the present time cost less than 1 per cent of the total investment.

Organization of Substation Department

The substation department of the company is organized in three divisions—the departments of inspection, operation, and reserve steam plants and repairs.

The head of the inspection division makes a general inspection of all substations approximately every two weeks. The detailed inspections made by the operators are uniform and are carried out in accordance with an inspection schedule which is posted in all substations. The schedule calls for the inspection of each particular piece of apparatus by a particular man at a particular time. The inspection is very thorough. Defects are promptly reported and measures are taken to remove them. They are thus usually corrected before damage results. This is especially necessary in such a large system where the responsible head cannot be familiar with the condition in detail of each piece of apparatus. An independent inspection is also made by the relief men, who take regular eight-hour shifts in the substations for the purpose of giving the regular men a shift off at intervals.

In the development of the system of substations the latter's first function was to transform the twenty-five-cycle current received from the power plants to direct current for lighting and power circuits. Later, frequency-changing substations became a feature as the demand for sixty-cycle current increased. The Edison system in Chicago was, of course, a purely direct-current network at first. It soon, however, reached the limit of the economical radius of distribution directly from the generating stations with low-tension direct current, and the range had to be increased by means of alternating-current transmission. As much direct-current generating equipment was already installed the first step was to use inverted rotaries in the generating stations, and this was done at Harrison Street and at Washington Street. Units of 250-kw capacity were used for this purpose, and these supplied 100-kw units in two substations. This temporary expedient was later rendered unnecessary by the installation of alternators in the Harrison Street plant. A 2500-kw double-current generator, which is now performing rotary-converter duty, was also installed in this plant. As alternating current demonstrated its suitability for

lighting, a demand for sixty-cycle current arose. This was met by the installation at first of small high-frequency generators and later by the introduction of frequency changers installed at outlying points. The sixty-cycle load grew until at present a total of 25,000 kw in frequency-changing sets is in use. The largest of these, a 5000-kw machine, is in the Quarry Street

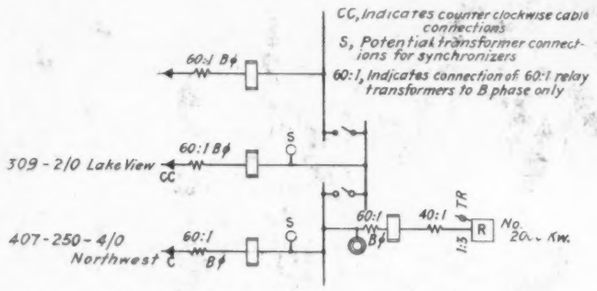


FIG. 12—DIAGRAM FOR ELEVATED RAILWAY SUBSTATION WITH TRANSFER BUS

station. Recently several very large sixty-cycle generators have been installed in the newer power plants, and the frequency changers serve a useful purpose as reserve capacity and in tying together the twenty-five-cycle and sixty-cycle systems. They are used principally during the annual peak periods. The new 20,000-kw horizontal turbo-generator now being placed in the Fisk Street station is a sixty-cycle machine, while the frequency of the new 25,000-kw generator output is twenty-five cycles.

On May 1, 1913, the substation equipment comprised about 184,000 kw of substation apparatus of all kinds. There were rotaries of 81,000-kw rating, 22,500 kw of motor-generators, 46,400 kw of 12,000-volt, sixty-cycle transformers, 22,200 kw of storage batteries rated on a one-hour discharge, and 12,000 kw of railway-company equipment operated by the Edison company.

Substation Operating Methods

The company in some instances supplies all requirements in a given territory from one substation. By

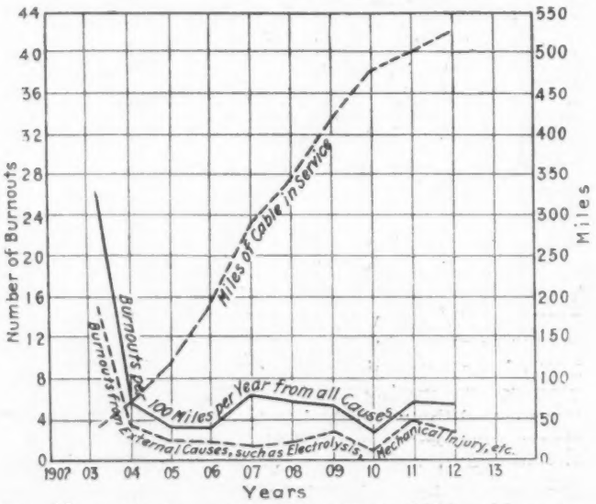

Number of Burnouts
Miles
Years
Miles of Cable in Service
Burnouts per 100 Miles per Year from all Causes
Burnouts from External Causes, such as Electrolysis, Mechanical Injury, etc.
1902 03 04 05 06 07 08 09 10 11 12 13

FIG. 13—RECORD OF BREAK-DOWNS OF 9000-VOLT TRANSMISSION LINES

combining the various kinds of service the load-factor is very materially improved and duplication of investment is avoided. Arrangements recently made with the railway companies are such as to render it possible to shut down most of the railway power plants except during the annual peak period.

The superintendent of substations, Mr. E. F. Smith, is responsible for everything connected with the conversion of electrical energy in the Edison substations. In addition to its forty-eight substations, the substation department maintains and operates during annual peaks two steam reserve plants. Of these the Harrison Street plant, once the show power station of the world, has a generating capacity of 14,000 kw, provided by twenty-four boilers and nine generating units. Two 2000-kw rotaries supply direct current for local distribution. A 2500-kw double-current generator, which is still occasionally used to accommodate the downtown load, is also in service as a rotary converter. There are also several smaller rotaries in the plant. At Fifty-sixth Street is a combined reserve steam and frequency-changing plant containing, in addition to the motor-generator sets, stationary transformers for use in the 4000/2300-volt, four-wire, three-phase distribution system. The lower voltage from the neutral to the main wires is used for lighting, and the higher voltage between main wires for power purposes.

Training Substation Operators

In view of the great importance of insuring absolute reliability on the part of substation operators, whose

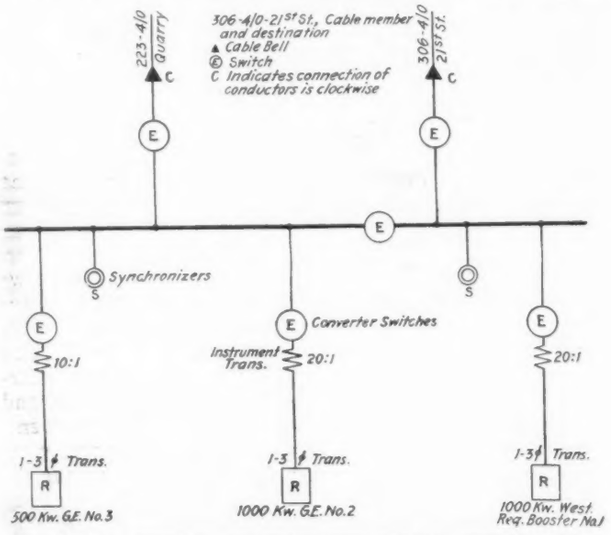


FIG. 14—TYPICAL DIAGRAM FOR SMALL SUBSTATION

most important duties are performed in emergency, the company has devoted special attention to the training of these men. This work is under the general charge of Mr. A. E. Evans, general operator in charge of the operating division of the substation department.

To insure accurate and quick work in emergencies constant vigilance on the part of the operators is needed. Nervous men cannot stand this. All applicants for positions are required to pass a thorough physical and mental examination, which includes tests of eyesight, ability to distinguish color, predisposition to nervousness, etc. New operators serve a term as apprentices and as such receive a thorough training, averaging four months in duration. The chief operators are responsible for the instruction, and they submit weekly reports of progress. On the average one hour per day is devoted to instruction and one hour to the study of the rules, making wiring diagrams, etc. The rest of the time is given to routine operation, cleaning machines and general "janitor" work. Apprentices work ten hours per day, operators eight.

The apprentices gain experience with all forms of equipment and are expected to make steady progress. Promotions are made on the basis of efficiency and

seniority. Examinations are conducted by a small examining board consisting of members of the substation staff and the chief operator. Quarterly examinations are held for all classes of operators. A merit or efficiency system is the basis of the ratings, and attendance, punctuality and performance of duty are all considered in the quarterly grading. Reports and ratings

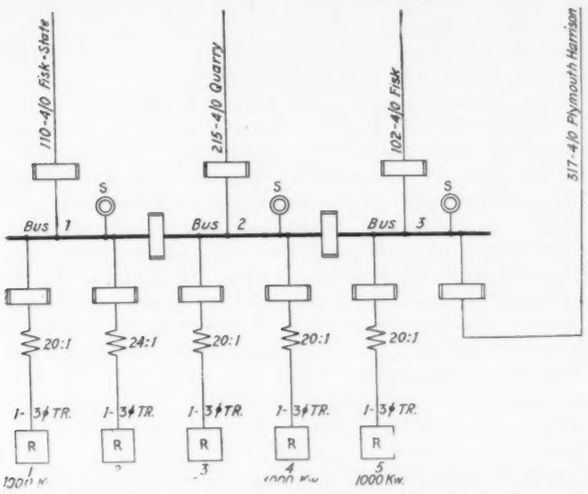


FIG. 15—TYPICAL LARGE SUBSTATION WITH TIE-LINE CONNECTION

are forwarded through a committee to the head of the substation department, who fixes the final rating of the department for each individual.

By averaging data of all certified operators it is possible to draw a picture of a composite operator, of whom the following may be said: He entered the service at

TABLE III—STORAGE BATTERIES, COMMONWEALTH EDISON COMPANY, CHICAGO

Substation	Plates	Date Installed	Ratings: One Hour Amp-hr.	One Hour Kw-hr.	One and One-Half Hours Amp-hr.	One and One-Half Hours Kw-hr.
Adams Street, No. 1	87H	May '98	11,400	1425	12,996	1624
Adams Street, No. 2	81H	Oct., '99	11,400	1425	12,996	1624
Adams Street, No. 3	81H	Oct., '01	11,400	1425	12,996	1624
Sedgwick Street	49G	Nov., '01	3,120	390	3,557	445
Fourteenth Street	33G	Oct., '01	2,080	260	2,371	295
Division Street	49G	Oct., '02	3,120	390	3,557	445
Harrison Street	61H	Nov., '02	8,550	1069	9,747	1218
Lydia Street	81H	Nov., '02	11,400	1425	12,996	1624
State Street	33G	Oct., '02	2,080	260	2,371	295
Haddock Place, No. 1	61H	Sept., '03	8,550	1069	9,747	1218
Haddock Place, No. 2	61H	Nov., '03	8,550	1069	9,747	1218
Morgan Street	33H	Oct., '03	4,560	570	5,198	650
Ohio Street	49H	May, '04	6,840	855	7,797	975
Market Street, No. 1	73H	June, '04	10,260	1283	11,696	1462
Wabash Avenue, No. 1	61H	Oct., '05	8,550	1069	9,747	1218
Wabash Avenue, No. 2	61H	Nov., '05	8,550	1069	9,747	1218
Plymouth Place, No. 1	61H	Nov., '05	8,550	1069	9,747	1218
Plymouth Place, No. 2	61H	Oct., '06	8,550	1069	9,747	1218
West Twenty-second Street	33H49	Nov., '05	4,560	570	5,198	650
Market Street, No. 2	115H	Dec., '09	19,000	2375	21,509	2687
Indiana Street	33H	Dec., '09	5,320	665	6,064	758
Twenty-seventh Street	37H51	Oct., '11	6,000	750	6,840	855
State Street, No. 2	33H67	Nov., '12	5,320	665	6,064	758

twenty-four and one-half years of age and served an apprenticeship of five and one-tenth months, receiving during this period 21 cents per hour. He has been in service four and one-fifth years and is now, therefore, twenty-eight and seven-tenths years old. He works 232 hours per month in eight-hour shifts. He operates 563 kw of motor-generators, 2250 kw of rotary converters, 600 kw of storage battery and 1100 kw of 12,000-volt, sixty-cycle transformers.

Of the operating force 47 per cent are married and 68 per cent are members of the Commonwealth Edison section of the National Electric Light Association. Ninety per cent of those eligible are subscribers to the employees' saving fund. The men hail from nineteen

TABLE IV—SAMPLE DAILY STORAGE-BATTERY RECORD

DAILY REPORT OF BATTERY FLOATING—BATTERY NO. 1

To. D. Macrae. Substation, State Street. Chief Operator, Critchfield. Date, July 2, 1913

Time	Bus Voltage	Cells in Circuit	Voltage per Cell	Amp-hour meter in ampere-hr: Charge	Amp-hour meter in ampere-hr: Discharge	For floating at an average of 2.12 volts per cell: Voltage	For floating at an average of 2.12 volts per cell: Cells in Circuit
1:00 P.M.	245	116	2112	....	....	236 to 238	112
4:10 P.M.	247	117	2111	....	....	238 to 240	113
5:00 P.M.	245	116	2112	....	....	240 to 242	114
5:30 P.M.	243	115	2113	....	....	242 to 244	115
5:40 P.M.	241	114	2114	....	....	244 to 246	116
6:15 P.M.	243	115	2113	....	....	246 to 248	117
8:00 P.M.	245	116	2112	....	....	248 to 250	118
8:40 P.M.	243	115	2113	....	..	250 to 252	119
11:00 P.M.	241	114	2114	....	....	252 to 254	120
1:00 A.M.	238	112	2125	....	....	.....	.....
7:00 A.M.	241	114	2114	....	....	.....	.....
7:45 A.M.	243	115	2113	....	....	.....	.....
8:50 A.M.	245	116	2112	....	....	.....	.....
10:40 A.M.	249	118	2110	....	....	.....	.....
12:05 P.M.	247	117	2111	....	....	.....	.....

states and Canada, and all have a grammar-school education, 54 per cent having attended high school. Eleven per cent are college graduates, while 21 per cent attended college but did not graduate. Fifty-eight per cent have studied correspondence-school courses, and of these 17 per cent completed them, a percentage considerably higher than the average of all students of correspondence schools. Each operator performs an

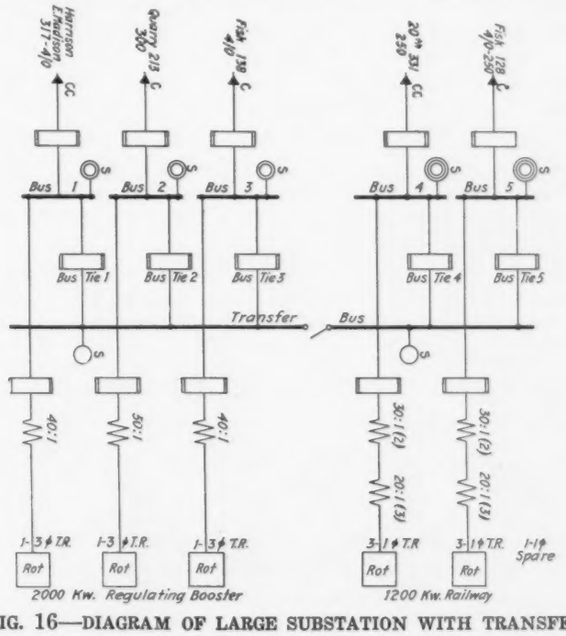


FIG. 16—DIAGRAM OF LARGE SUBSTATION WITH TRANSFER BUS

average of six "serious" operations per day, or 2300 per year. Errors made by the entire operating force are at the average rate of one every ten days, or one for each operator in three and one-third years. There has never been a fatal accident in the substation department.

All operating errors are thoroughly investigated and

the blame placed. Extra good service also receives official recognition. The essential details of troubles resulting from operating errors are distributed through bulletins, and instructions for avoiding repetitions thereof are given. The results of such work have been a constant improvement in the efficiency of the operating force. To indicate this it may be said, in addition

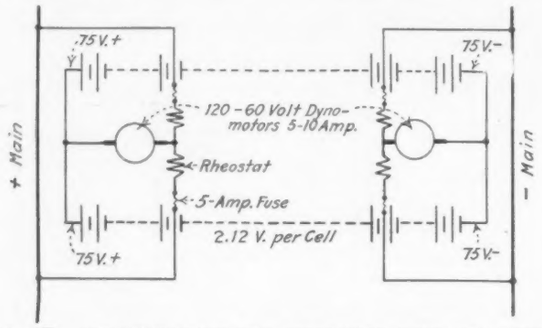


FIG. 17—ARRANGEMENT FOR CHARGING STORAGE-BATTERY END CELLS

to the data given earlier, that in 1910 out of 238,000 serious operations fifty-one errors were made, an average of 0.49 per man. In the 284,000 operations made in 1913 up to the time when these data were compiled, there were but thirty-three errors, or 0.20 per man.

Storage Batteries

So much depends upon absolute reliability of lighting service in a large city that the storage battery is practically a necessity in the business section. Unexpected darkness in a large department-store basement, for example, would result in possible panic and almost certain loss through theft. The Edison company, therefore, has a large number of batteries so distributed that failure of direct-current supply is practically impossible. The dates of installation, types of plates and capacities of these are given in the accompanying table and the locations are shown on the map. These batteries are always kept fully charged for emergency use. The cost of their upkeep should be charged, therefore, to service insurance.

The same principle is applied in the power plants and substations where smaller batteries are installed for

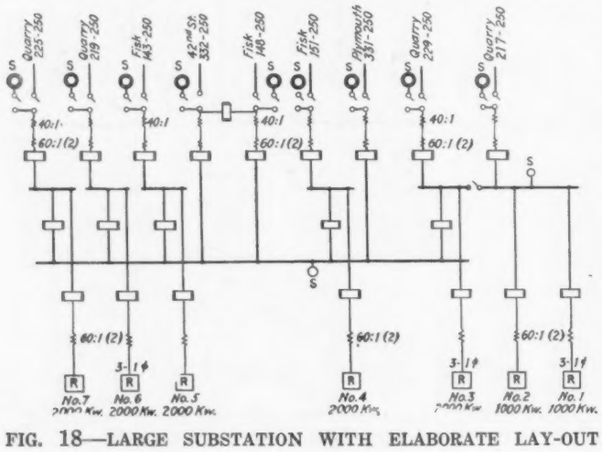


FIG. 18—LARGE SUBSTATION WITH ELABORATE LAY-OUT

reserve oil-switch operation and alternator excitation. For the former purpose sixty-cell batteries having a capacity of 80 amp each for one hour are employed. These serve also to supply energy for auxiliary emergency lighting. Exciter batteries are operated in parallel with the exciter busbars and in most cases contain seventy cells each. They are rated at from 680 amp to 1100 amp. Three such are installed at Fisk Street, two at Quarry Street and two at the Northwest station.

At present the batteries are being renewed by means of "Exide" plates, which have higher capacity at high rates of discharge than the Manchester plates and also occupy less floor space for equal ratings. The Manchester plates increase in rating as the lead supports are turned into active material until they actually drop apart. In spite of their durability, however, the advantages mentioned for the "Exide" plates have brought about the change to the latter type.

In all substations the batteries are floated on the bus at 2.12 volts per cell. This provides for a slight charge and makes up for the slow discharge due to local action. At the normal temperature of 70 deg. Fahr. a cell of 61H Manchester plates, 2.5 amp is required to hold the cell voltage at 2.12 volts. All batteries are given fifteen-minute freshening charges at one-fourth of the one-hour rate. If this produces gassing, the cells are considered in good condition, otherwise they are reported as defective on a form like that shown herewith. Every two weeks the batteries receive an overcharge for two hours to make up for any losses which may have occurred.

An interesting and effective plan for charging the

Form O. B. 1

Date July 2, 1913.

DAILY BATTERY REPORT OF CHIEF OPERATOR FOURTEENTH STREET SUBSTATION

To MR. E. LUCERNE,
Superintendent of Storage Batteries.

The following cells in No. 1 *battery did not gas freely during the last charge ending* July 1, 1913:

.....

POSITIVE SIDE—13 +.....

NEGATIVE SIDE—O.K.....

E. K. ELGIN,
Chief Operator.

FIG. 19—SAMPLE DAILY STORAGE-BATTERY REPORT

end cells is in operation in the Wabash Avenue substation. The scheme is illustrated in Fig. 17. There are two batteries operated in parallel, the positive and negative mains being connected at the points required to give 2.12 volts per cell. Between these points and the respective ends of the battery are connected dynamotors of from 5-amp to 10-amp capacity. In each branch of the dynamotor-battery circuit are an adjusting rheostat and a 5-amp fuse. The end cells are thus continually charged like those in the sections connected across the mains.

Once each week the specific gravity of each cell is measured and recorded on a special form, and the forms are assembled in a book for ease of comparison and study. A record of charges and discharges by months is also made. When plates are reported as defective, the first indication of defect being failure to gas under overcharge, they are sometimes replaced by used plates. New and old plates are never assembled in the same cell. After repair the cell is given a four-hour charge by means of a booster. In addition to the reports mentioned daily reports of the operating condition of each battery as a whole are filed. Each operator has instructions to adjust the number of cells in service to correspond to changes in busbar voltage and to record the time and battery data whenever such adjustment is made. A sample record is given in Table IV.

High-Voltage Direct-Current Electrification

Use of electric energy for railway operation purely for economical reasons—Special equipment necessary because of high pressure of 2400 volts direct current

THE electrification of the Butte, Anaconda & Pacific Railway is distinctive for two reasons, first because the high pressure of 2400 volts direct current is used and secondly because it is one of the first cases in which steam operation has been displaced by electricity purely for reasons of economy. The electrified lines of this system extend from the Butte Hill railway yards, near which copper is being mined, to the smelter at East Anaconda. The total mileage on a single-track basis, including sidings, tracks in yards and smelter tracks, is about 95 miles. Although the main object of the road is to haul ore, there is considerable local traffic, both freight and passenger, between Butte and Anaconda, the former city having a population of about 65,000 and the latter of about 10,000.

The freight traffic consists largely of copper ore and amounts to more than 5,000,000 tons per year. This material is hauled in steel ore cars each weighing about 18 tons and having a capacity of 50 tons. Trains of thirty loaded cars weighing 2000 tons are made up at the Butte Hill yards and are hauled by two-unit locomotives down the mountain to the Rocker yards, a few miles west of Butte, where 4000-ton trains are made up for the main line. At the East Anaconda yards the trains are again broken up and 1400-ton trains are sent up Smelter Hill to the ore bins. All of the shifting and "spotting" of cars at the smelters and in the sorting yards is done by single locomotive units.

The first electric locomotives were put in service May 28, 1913, and were used to haul ore cars between the East Anaconda yards and the smelter. During the first seven months of service they made approximately 201,000 miles and hauled about 2,365,000 tons of ore.

Eight passenger trains per day are operated between Butte and Anaconda, four in each direction. The main-line trains were first hauled by electric locomotives on Oct. 1, 1913, and promptly demonstrated their ability to make better time than was possible with steam engines. Single locomotives are used, hauling trains of from three to five passenger and baggage cars.

Energy for the operation of electric trains is purchased from the Great Falls Power Company. The gen-

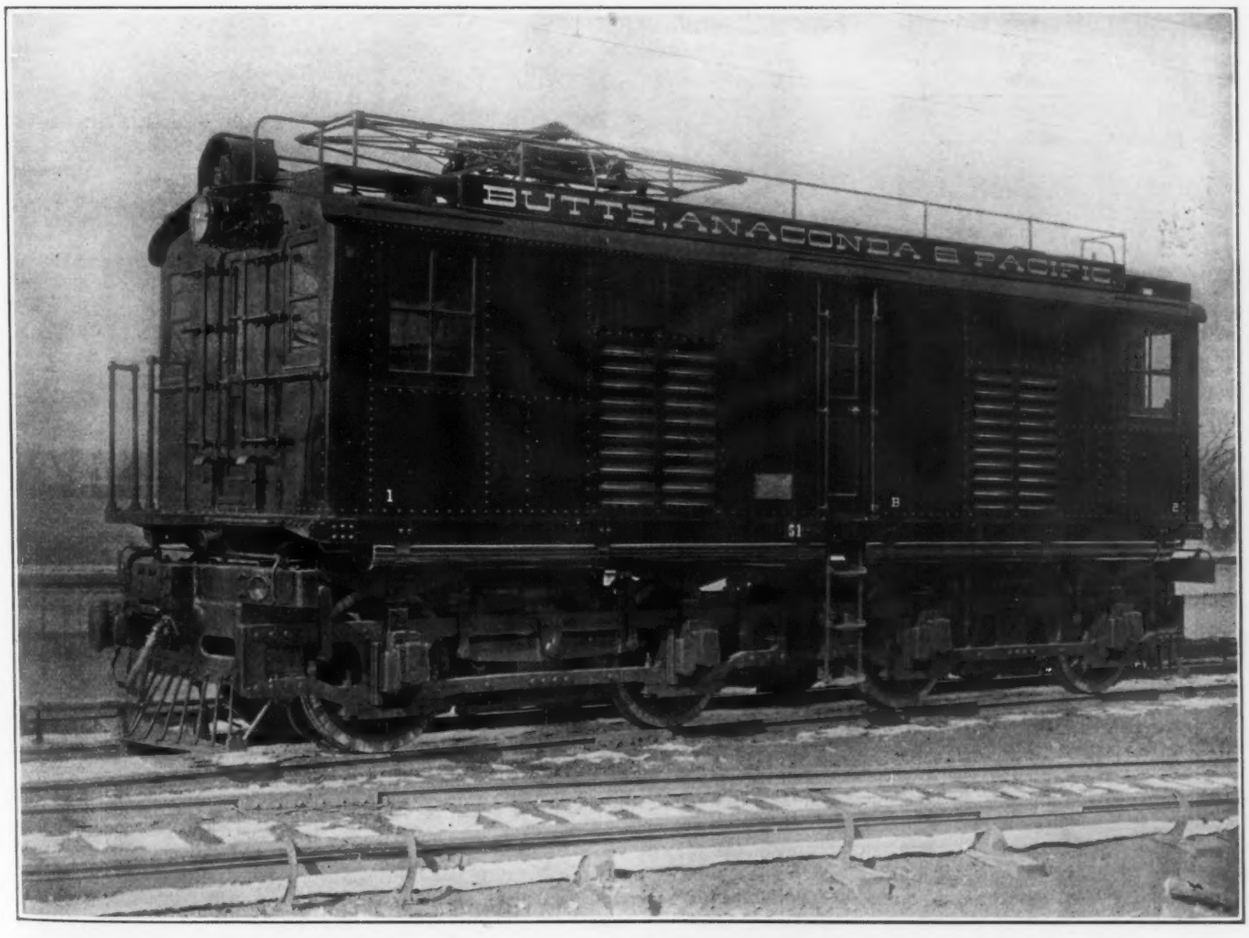


FIG. 1—2400-VOLT DIRECT-CURRENT LOCOMOTIVE, BUTTE, ANACONDA & PACIFIC RAILROAD

erating plant is situated at Great Falls, Mont., on the Missouri River, and has for some time been supplying electric energy for the operation of the mines and smelters at Butte and Anaconda. Six hydroelectric units are installed, having a nominal rating of 21,000 kw. The machines are of the horizontal type, generating 6600 volts, three-phase, at a frequency of sixty cycles.

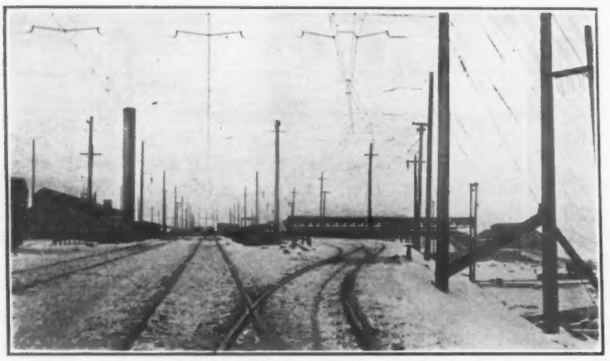


FIG. 2—OVERHEAD CONSTRUCTION

The emf is stepped up to 102,000 volts for transmission to the transformer substation at Butte, a distance of 130 miles, over two separate parallel lines constructed on the same right-of-way. An extension of the system transmits energy at 60,000 volts to a second transformer station at Anaconda, 26 miles farther on.

The two existing substations at Butte and Anaconda were used to house the 2400-volt motor-generator sets required for operating the electric trains, so that no additional buildings were constructed for this purpose. Energy is obtained from two 1000-kw, three-unit motor-

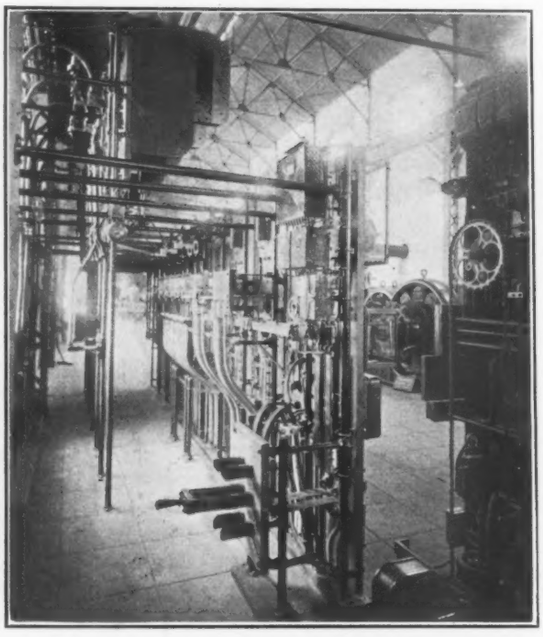


FIG. 3—2400-VOLT SWITCHBOARD, BUTTE SUBSTATION

generator sets in each substation, which take energy from the 2400-volt alternating-current buses. These units operate continuously twenty-four hours per day and seven days of the week to supply the necessary energy for train operation. Each set consists of a three-phase, sixty-cycle, 1450-kva synchronous motor operating at a speed of 720 r.p.m., which is directly connected to two 500-kw, 1200-volt generators, insulated to operate in series for 2400 volts.

The 2400-volt switchboards for controlling these sets are said to be the first direct-current boards to be constructed for such a high voltage. In general, they are similar to the standard 600-volt types excepting that they have increased insulation and special provision for interrupting the 2400-volt current. The circuit-breakers and switches are also arranged for remote control, and all apparatus on the panels is provided with ample insulation to insure safety to operators.

The 2400-volt circuit-breakers and switches are installed on separate panels above and back of the main panels and are operated by connecting rods from handles mounted on the front of the main switchboard. These handles are similar in appearance, and to avoid confusion the circuit-breaker handles are inverted. The breakers are equipped with special magnetic blowouts and arc chutes, and provision is also made for automatically inserting a high resistance in the generator-field circuit at the same instant the main circuit-breakers open, thus reducing the generator voltage.

The alternating-current switchboard contains two panels for remotely controlling the synchronous motors,

FIG. 4—SECTION SWITCH AND OPERATING LEVER

solenoid-operated oil switches, two panels for the motor-field circuits and a panel for the automatic voltage regulator. These panels also contain other necessary instruments, including frequency and synchronism indicators, ammeters, wattmeters and relays.

The overhead construction for this system was especially designed to give the flexibility necessary for satisfactory operation of the pantograph trolleys used on the locomotives. The 4-0 grooved copper trolley used over all tracks is supported by an eleven-point catenary suspension from a stranded-steel messenger cable. Both side-bracket and cross-span construction is used as required by the local conditions.

The section breakers were designed for the 2400-volt service, and at six points insulated crossings are necessary at the intersection of the 2400-volt trolley with the 600-volt trolley of the city system. On the main line use is made of a very simple section insulator, the two trolley wires from the ends of each section being paralleled at a suitable distance for insulation, so that the pantograph bridges the two circuits for a short distance, thus avoiding interruption of the supply of energy to the locomotive. The construction in the yards

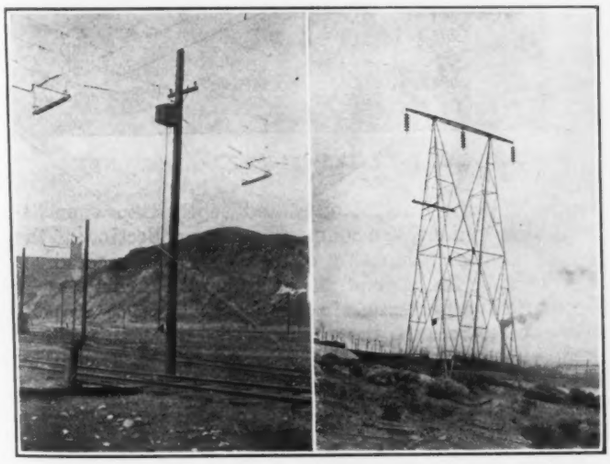
and sidings is simplified by paralleling the trolley from the side tracks for a short distance along the main line. This arrangement avoids the use of switch plates or similar devices. At some of these junction points the pantograph engages as many as six trolley wires.

The 4-0 trolley is reinforced between the substations with two 500,000-circ. mil bare copper cables tapped to the trolley at intervals of 1000 ft. A 4-0 negative return wire is also installed between Rocker and East Anaconda. This wire is carried on the trolley poles and is connected to the cross bonds at intervals of 1000 ft. The rails are connected by 4-0 bonds at every joint. The substations are normally connected together by these feeders, allowing an interchange of energy. In emergency either station can supply energy to the entire system.

The locomotive equipment consists of seventeen 80-ton units, fifteen for freight and two for passenger service. The freight locomotives are geared for low speed and are operated in pairs for the main-line service. The maximum free-running speed is 35 miles per hour. The two passenger locomotives are of the same construction as the freight units, but are geared for a maximum free-running speed of 55 miles per hour. A speed of 45 miles per hour is made with three passenger coaches on straight level track. The continuous tractive effort of a single 80-ton freight locomotive is 25,000 lb. at 15 miles per hour. The maximum tractive effort for a period of five minutes is 48,000 lb. based on a tractive coefficient of 30 per cent.

The locomotives are of the articulated double-truck type with all the weight on drivers. The central channels forming a part of the underframe are inclosed and are utilized as a distributing air duct for the forced ventilation of the motors. The air is conducted through the center pins, which are hollow, into the truck transoms and thence to the motors.

The motors are of the GE-229-A commutating-pole type and coil wound for 1200 volts and insulated for 2400 volts. The motor is designed for locomotive service and is provided with forced ventilation. In the ventilation of these motors the volume of air circulated is increased by the use of an auxiliary blower mounted on



FIGS. 5 AND 6—SECTION SWITCH AND STEEL TRANSMISSION TOWER

an extension of the dynamotor shaft. The gear reduction on the freight locomotive is 4.84 and on the passenger locomotive 3.2. The double-unit, 160-ton locomotive is capable of giving a continuous sustained output of 2100 hp. The motors are connected to the driving wheels by twin gears.

The control equipment is Sprague-General Electric multiple-unit type, operating the four motors in series and in series-parallel. Two 1200-volt motors are permanently connected in series. The controller provides ten steps in series and nine in series-parallel. The transition between series and series-parallel is effected without opening the motor circuit, and there is no appreciable reduction in tractive effort during the change.

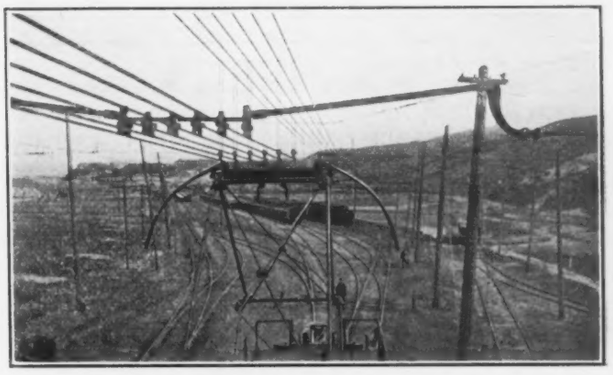


FIG. 7—OVERHEAD CONSTRUCTION IN YARDS, PANTOGRAPH ENGAGING SIX WIRES

The transfer of circuits at this point is made by a special change-over switch, which is operated electro-pneumatically.

The 2400-volt contactors are operated from the 600-volt control circuit and are specially constructed to separate the 2400-volt parts from the coils and interlocks which carry the 600-volt current. The necessary insulation is obtained by large clearances and by the use of porcelain and mica insulation. The armature is connected to the contact lever by a wooden rod. The contacts, magnetic blowout and arc chutes are also especially designed to rupture the 2400-volt arc.

Energy is collected by overhead roller pantographs, which are pneumatically operated and are controlled from either of the engineer's compartments by an air valve. A 2400-volt insulated bus line runs along the center of the cab roof. These bus lines are connected together by couplers between the two freight units, so that energy may be obtained from either one or two collectors.

For operating the control equipment and air compressor and for lighting the locomotive and cars 600-volt energy is supplied from a 2400-to-600-volt dynamotor installed on each locomotive.

All of the passenger and baggage cars now used between Butte and Anaconda will be heated as well as lighted by electricity as soon as the equipment can be installed. The cars will be heated from a single heating unit placed underneath the car floor and supplied with energy from a 2400-volt bus connected directly to the 2400-volt bus on the locomotive. This unit will have a maximum capacity of 25 kw and will be used to heat the air which is distributed to different parts of the car by means of a small motor-driven blower. Cool air will be drawn into the insulated case inclosing the heating units from some point on the roof of the car. After passing over the heating coils the air will be carried through ducts under the floor of the car to radiators placed between alternate seats. The blower has a capacity of from 500 cu. ft. to 1000 cu. ft. of air per minute, and the motor is connected in series with the heating units.

Standard 600-volt lighting fixtures will be used on the cars, and each passenger and baggage coach will be wired for five groups of five lamps in series. The lights in each car will be controlled by a suitable master switch and fuse with snap switches in the individual circuits. Thirty-six-watt tungsten lamps will be used.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

New Book of Rate Schedules in Chicago

The Commonwealth Edison Company of Chicago has issued a new book of rate schedules. This is a loose-leaf book laid out on the lines suggested by the rate research committee of the National Electric Light Association. The first sheet gives the table of contents; the second, a preliminary statement of general information; the third, Rate A, or the general service rate, and so on, the entire book consisting of twenty-five sheets. A large portion of the book is devoted to the standard contract riders, and the publication contains complete information about all the rates of the company, simply and clearly expressed. It may be noted that there are five general classifications of rates as follows: Rate A, general service; Rate B, regular power service; Rate C, large light and power service; Rate D, sign-lighting service (meter basis); Rate E, flat-rate lighting service. The number of standard contract riders which may modify the rates is thirty-two.

The "Electric Corner" at Cambridge, Ohio

Taking one of the darkest corners in the business section of Cambridge, Ohio, the New Midland Power & Traction Company recently equipped the cornice of its two-story office building with the row of lamps shown in the accompanying illustration, with the result that this section is now one of the most popular and attractive in the city. The benefits of moving the company's headquarters from an out-of-the-way location

CENTRAL-STATION OFFICE AT CAMBRIDGE, OHIO

to the present site opposite the court house have also been reflected in the increased sale of electric appliances as well as in the greater number of tickets purchased for the company's interurban railway line. The business office itself is brilliantly lighted, as revealed in the photograph, and the new "electric corner" is now one of the bright spots of Cambridge, contributing its share to the increasing local standard of illumination. Mr. W. S. Hays is superintendent of the New Midland Power & Traction Company.

Energy Consumption of Electrically Operated Gristmills

Among the off-peak motor loads of the Illinois Northern Utilities Company, which operates in the vicinity of Dixon and Sterling, Ill., are some fifteen gristmills, each containing from 50 hp to 60 hp in motors. By the terms of a special form of contract granted gristmill operators energy is obtained at a net rate of 3.5 cents per kw-hr. provided that the mill load is kept off the lines from 4:30 p. m. to 10 p. m. during the entire year. For the

ELECTRICALLY OPERATED GRISTMILL AT DIXON, ILL.

months of June, July, August and September, when little milling is done, the company waives collection of the 50-cent minimum monthly charge per hp connected.

In serving these gristmill customers the company is automatically protected in the observance of its off-peak clause, because the farmers who come to town to have grinding done invariably start home by 4:30 p. m. to get their evening milking finished. This insures, of course, that the mills will be shut down in ample time to avoid the evening lighting peak.

The average annual income from gristmill customers is now about $1,800, although there are three or four months in the year when little grinding is done.

One of the most efficient of the company's gristmill installations, according to Mr. C. B. Yonts, general contract agent, is the Sprout-Waldron attrition mill of the Dixon Cereal Company. On an actual test of grinding 15 tons of corn and cobs and corn and oats, the energy consumption of this mill was but 110 kw-hr. At the 3.5-cent off-peak rate, this is equivalent to 26.4 cents per ton. The average rate for grinding is 10 cents per

100 lb. The mill in question employs two 20-hp motors direct-connected to disks running in opposite directions. The output of this equipment is almost 50 per cent greater than that of other attrition mills in use in the Dixon territory, which are belt-connected to a single 50-hp motor. The cost of grinding with such a belted outfit averages about 60 cents per ton, based on figures covering a three-month period during which both old and new corn was ground.

One old-type 50-hp belt-connected mill in the vicinity charges 6 cents per bag for grinding, although the cost is but 3.1 cents. Another old-type mill belt-driven by a 75-hp motor charges 5 cents per bag, while the cost is only 2.25 cents per bag. In the case of still another 50-hp belt-driven installation the cost is but 3.05 cents per bag, but the charge made is 6 cents per bag.

One gristmill in the Illinois Northern district was recently converted into a combination grist and merchant mill. In the past it had been operated only during the winter months, but when the son of the former owner took over the business the significance of load-factor was explained to him, with the result that he put on two eight-hour shifts and took advantage of the company's maximum-demand rate. This mill is now operating twenty-four hours a day and has a load-factor of about 85 per cent. Whereas the company's income from the former mill averaged about $50 per month, the present mill is returning $350 per month, and the operator is well satisfied.

In addition to the milling business described, the company also serves a number of canning plants in the vicinity. Nearly all of this canning is done during the four summer months, when the gristmills are closed down, thus enabling the same transformers to be used for both purposes and giving the company a good annual load-factor between the two seasonal demands.

"Hooking Up" Dayton's Wired Houses

It nets the electric-service company no return to have wired houses and stores in its territory unless they are connected to its lines and are using electrical energy.

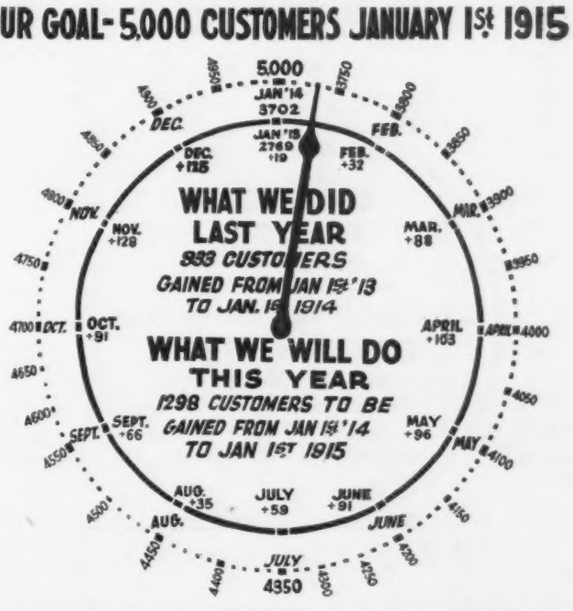
CARTOON USED AT DAYTON (OHIO) TO INCREASE BUSINESS

The accompanying cartoon shows how the Dayton Power & Light Company is keeping down the percentage of such buildings. As is stated in the text accompanying the picture: "A friendly contest between departments has been started to ascertain which department can turn over to the sales department the greatest number of leads from which new business may be secured. Every employee is asked to co-operate and turn over to the head of his department the street address of any house or store that he knows is wired and where electric light is not being used." The twin slogans of the contest are "Watch for services not connected" and "Mark it down!"

Cartoons such as the one shown herewith have been posted on the company's bulletin boards and in other conspicuous places, reliance being placed upon the picture of the man "marking it down" to attract the attention of his fellow employees and to tell them the story almost without the aid of the text. Mr. Thomas F. Kelly, sales manager for the Dayton company, believes the cartoon idea will be a business getter.

Setting the Pace at New Britain, Conn.

During the year 1913 the New Britain division of the United Electric Light & Water Company of Connecticut achieved a record for the new business added to its lines. A net gain of 933 customers, or 33.5 per cent, was made, bringing the total number of customers connected on Jan. 1, 1914, to 3702. Feeling that this



CLOCK DIAL TO SHOW INCREASE IN CUSTOMERS

record was one in which to take just pride, the organization has now set out to make an even better showing for 1914. To keep up the enthusiasm of the employees and to hold them in closer touch with the sales department's work, the large clock dial shown herewith was prepared and mounted on beaver board, 44 in. by 44 in. On the inner circle the monthly gain of customers for the year 1913 is shown, while on the outer circle the months for the year 1914 are laid off, and every employee is urged not to let any 1913 month's record stand. The first of each month the hand is moved up to show the actual number of customers on the lines at that time, and if the record of the year before is broken, a fresh start is made on the next month. The campaign was launched with the slogan "Our goal—5000 customers Jan. 1, 1915," and all employees have pledged their untiring support to make good this prediction. To attain the goal, a gain of 1298 customers for the year 1914, or 35 per cent, must be made, which means extra effort on the part of every employee—meter readers, installers, linemen, salesmen, superintendent.

The dial is placed in the main office at New Britain in full view of the public and employees, and much interest is shown in the progress of the hand. On pay day especially the linemen and other employees who come into the office only once a week evince added interest in the growth of the company's business, and all want to take an active part in the development. During the first month the record of January, 1913, was broken and a gain of 53 consumers was added against 19 the year before, or an increase of 279 per cent.

Different schemes will be used to stimulate interest in the campaign, and small prizes will be offered to the employees handing in the most "leads" that result in new business. Monthly talks to all the employees, thanking them for their efforts for the past month and advancing for the next month a new idea of some nature which will bring about general co-operation and enthusiasm, have also proved successful.

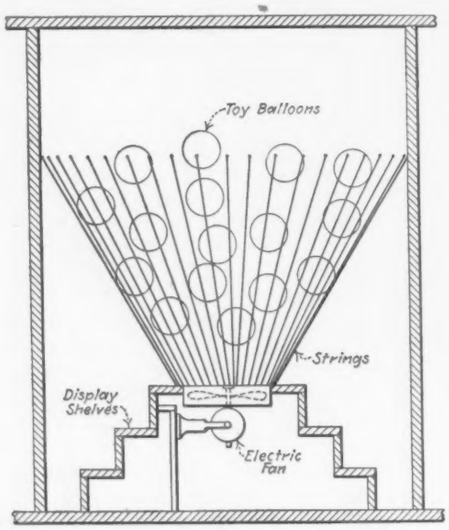
Mr. F. S. Troup is the contract agent for the New Britain division of the United Electric Company.

Displacing Gas-Heated Irons in St. Louis

Mr. C. E. Michel, manager of the appliance department of the Union Electric Light & Power Company, St. Louis, Mo., recently announced that the company would allow its customers $1 on the purchase price of any electric iron if they brought with them their old self-heated gas irons when they called to make their electrical purchases. At the end of the sale the company plans to load the old returned irons onto one of its electric trucks and, after treating them to a ride through the city, properly placarded, will dump the entire lot from the Eads Bridge into the Mississippi River.

A Fan-Driven Window Display

During the winter season a drugstore in Milwaukee, Wis., installed a rather novel electrical display to make its window more attractive. The drawing herewith shows the idea used. An electric fan was hidden beneath the pyramided shelves and sent its blast of air toward the ceiling. Varicolored toy balloons were retained within the fan's zone of action by a basket of strings arranged in the shape of a frustum of a cone. The balloons were driven about with attractive irregularity that compelled attention.



BALLOONS SHOWN IN WINDOW KEPT IN MOTION BY FAN

Illumination and Wiring

Shooting a Transmission Line Clear of Ice-Laden Branches

A severe sleet storm swept over west central Ohio early in February, putting many telephone and electric power lines out of commission. The 33,000-volt transmission line of the Greenville Electric Light & Power Company traversed the stricken district, and while no damage was done to the circuit itself, the line had to suspend operation owing to the great amount of ice on the insulators and cross-arms and to the falling of trees across the wires.

According to Mr. D. L. Gaskill, president of the Greenville company, a very novel method was finally resorted to in order to clear the line of the ice-laden limbs which dropped into contact with the wires at points between poles. These limbs were ordinarily out of the way of the wires except when bent down under the load of sleet, and their position on the trees was such that it was practically impossible to get at them to cut them off. Some one finally suggested trying a shotgun, and it at once proved entirely successful in clearing the line of these ice-coated limbs. About 300 shells were used altogether in clearing up 26 miles of line. In no case were more than two shots needed to sever the limb and bring it to the ground, and in some instances one shot so dislodged the ice as to allow the limb to return to its normal position.

Church Sign on Central-Station Service

"Welcome" signs of the electrically lighted type are often used by churches making an appeal to the passing stranger, but in many cases the signs are inharmonious with respect to church architecture and do not show to best advantage on account of their location. The accompanying halftone illustrates an electric sign which is in constant use by the First Baptist Church

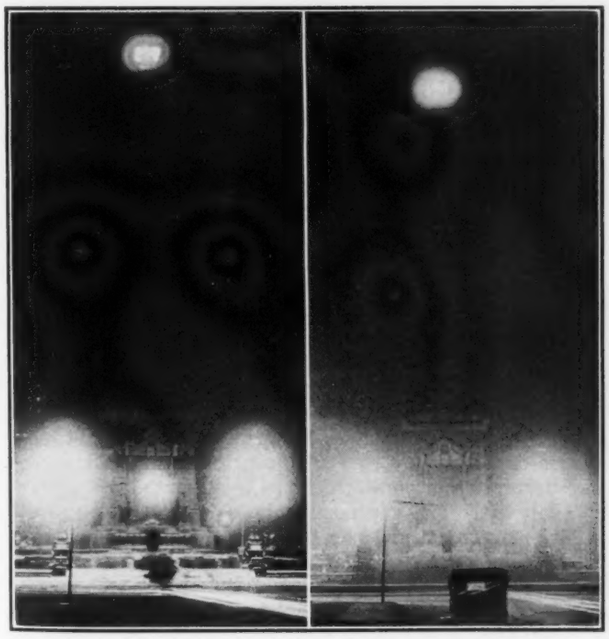
ELECTRIC SIGN FOR CHURCH

of Watertown, Mass., whose edifice is one of the most architecturally beautiful church structures in New England. In this case special care was taken to make the sign conform to the courses of stone blocks forming the tower, a straight horizontal design without superfluous ornamentation being adopted. Placed across the main entrance and directly above the arch, the sign does not detract from the appearance of the building, but conveys the sense of hospitality intended even when viewed from a considerable distance. The sign is 12.5 ft. long and 15 in. high and carries sixty-seven 4-cp lamps supplied from the 110-volt lines of the Boston Edison company. The sign is about 18 ft. above the top of the steps. The letters are painted white and are carried on a light angle-iron with the wiring run in inconspicuous pipe conduit.

Replacing Arc Lamps with Nitrogen-Filled Tungsten Units in Plaza Lighting

The Merchants' Heat & Light Company, Indianapolis, Ind., has just completed an installation of forty-eight 750-watt nitrogen-filled tungsten lamps on the circular plaza surrounding the beautiful Soldiers and Sailors' Monument which stands at the center of the Hoosier capital. The lamps used are the Westinghouse 750-watt multiple type, delivering approximately 1100 cp. The contract with the State of Indiana for the monument lighting called for 5-amp multiple-type arc lamps, and the change to the new high-efficiency tungsten lamps was made voluntarily by the Merchants' company for the purpose of determining the utility of the new illuminants.

The photograph from which Fig. 1 was made was taken while the old installation of arc lamps was still in service. The picture reproduced in Fig. 2, showing the tungsten units, was taken from the same spot as



FIGS. 1 AND 2—INDIANAPOLIS MONUMENT LIGHTED BY ARC LAMPS AND BY NITROGEN-FILLED LAMPS

the first and had the same length of exposure. It will be noticed that the intensity of illumination on the plaza is much greater with the new lamps. Fig. 3 shows the west side of the monument where the standards each carry eight lamps. The larger standards on the north side, seen in Fig. 1, have sixteen lamps each. An adequate idea of the superior illumination obtained with the new installation can hardly be gained from the

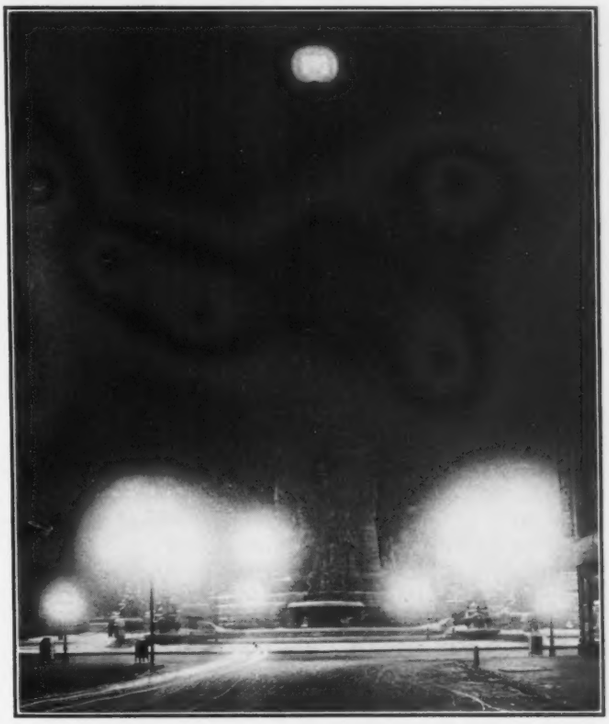


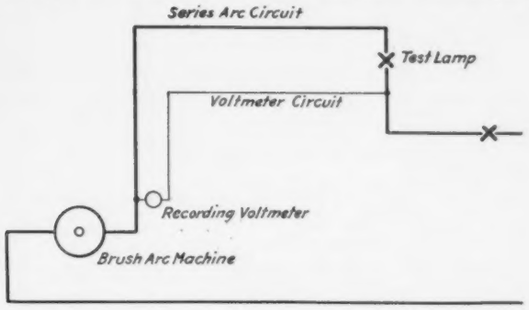
FIG. 3—WEST SIDE STANDARDS EACH EQUIPPED WITH EIGHT 750-WATT NITROGEN-FILLED LAMPS

photographs on account of the greater proportion of visual to actinic rays present in the nitrogen lamps compared with the arc units.

The fixtures for use with the new incandescent lamps were constructed of old arc-lamp casings. The diffusing globes are of the flaming-arc type and provide for free passage of air around the lamp bulb.

Testing Arc Lamps in Service at Mattoon, Ill.

After a lamp has been taken down from its position in the local lighting series circuit and repaired in the workshop of the municipal electric-light plant at Mattoon, Ill., it is hung on a street corner near the power



VOLTMETER CONNECTIONS FOR TESTING ARC LAMPS IN SERVICE

station to undergo an operating test under actual service conditions. Connections arranged as in the accompanying circuit diagram enable the recording voltmeter in the station to trace a voltage chart showing

the characteristics of the lamp's operation. This scheme according to Mr. W. S. Bury, city electrician, not only shows up the weak points of the lamp when operating out of doors, but also provides a chart of the system's operation if one is needed for future reference.

Recent Telephone Patents

A telephone-supporting bracket, patented by Mr. Farnham Fox, New York, is arranged to swing in a vertical plane, the base of the telephone set being maintained horizontally for all positions of the bracket. The relation of the parts is similar to that of a pantograph. Two of the arms are, however, hollow troughs, the edges of which are bent to lock together with a sliding contact and form together a rectangular bar. A counterbalance spring runs alongside of the bar, one end being secured to each part. Sufficient friction is maintained at the groove contact by short spiral springs, which tend to push apart the two portions of the bar.

Messrs. C. T. Porter and R. J. Osborne, of San Francisco, Cal., are the joint patentees of an antiseptic device. Sheet-metal clamps are placed between the mouthpiece and the face of the transmitter. The mounting consists of a strip of metal which extends forward above the mouthpiece to a point near the latter's lip. The strip is then carried upward a distance slightly greater than the diameter of the mouthpiece; it is next bent forward a short distance and then downward, this downward part being expanded into a disk slightly larger than the opening of the mouthpiece. A metal-incased pad of antiseptic material is mounted upon a horizontal pin which extends from the lower edge of the disk to the mounting. This pad may be swung down over the mouthpiece or up behind the disk. In this latter position a spring forces it tightly against the rear face of the disk.

Letters to the Editors

Meters on Unbalanced Circuits

To the Editors of the Electrical World:

SIRS: The two articles on polyphase metering in your issue of Jan. 17 deal with a subject that until very recently has not received the attention which it deserves, especially when it is considered that very often the bulk of a central station's income depends on the energy measured by polyphase meters. In both articles it is assumed that the meter elements and the instrument transformers are connected to their proper circuits and that the error in the connections consists only of a reversal in one of the circuits. In a great number of cases that have come to my attention the mistake in the connection was not simply a reversal but generally consisted of one or more incorrect connections of the meter elements or the instrument transformers to their proper source.

The two methods are to some extent based on the assumption that the load is balanced. Such a condition may exist approximately in a great many cases where the meter measures the energy consumed by a loaded three-phase motor. However, very abnormal and peculiar conditions of unbalancing may sometimes exist when a motor is running light. By no means is it permissible to make the assumption of balance on circuits carrying a complex load, as, for example, a load consisting of single-phase and polyphase motors and lamps. Both methods, however, appear to have a wide range of application for unbalanced condition at low power-factor, provided it is definitely certain which of the two elements is the so-called "slow element." In unbalanced conditions the element which on balanced condition would be the low reading one may actually be the high reading element. In the second method, with an unbalanced high power-factor condition and reversal of current phase in the low reading element, the conditions may be such that a forward indication would result when the common potential wire is opened. According to the rule given, a forward indication shows the connection to be correct, which, of course, in this particular case would not be true. Another condition that must be kept in mind is that with an unbalanced condition at high power-factor the difference in speed of the two elements may be mistaken for a condition of low power-factor.

It is not my intention to belittle in any way the effort made by the writers to formulate methods and rules for clearing up what is probably the most troublesome work a meterman is called upon to unravel. Both methods are sure to find useful application by metermen, but they must be used with caution and should not be left to be applied by a person who has no knowledge of meters, as it is claimed may be done with one of the methods. Such rules and methods are like keen-edged tools which work with ease in the hands of the artisan but which may slip when someone else manipulates them, and when this happens an injustice will be done to somebody which may be difficult to rectify or explain.

Albany, N. Y. J. P. GEBELEIN.

Sheet-Steel Economy in Magnetic Circuits

To the Editors of the Electrical World:

SIRS:—When a manufacturer of steel sheets places a new and highly improved product upon the market theory would lead one to suppose that engineers and designers would rush in and devour the new product. Sheet steel for magnetic structures can be so satisfactorily tested in the course of two weeks that no possible doubt of its character need trouble the most conservative. The fact is, however, that engineers and designers, the exponents of conservation and economy, do no such thing, and it isn't because of the cost of the new article.

Maybe the new material thoroughly justifies a premium price of even a few dollars per ton, which might reflect upon the cost of the average motor as much as the one-one-hundredth of 1 per cent. The keen commercial side of the designer greets the new offer with the argument as follows:

"To get full value from the new material I must change my designs; that means expensive new dies, costly alterations of patterns and new routine. No, I must not do that now, for having done it I am at the mercy of your product—at the mercy of one producer whose caprices may run up the price to me, curtail my supply or hamper my freedom in other ways."

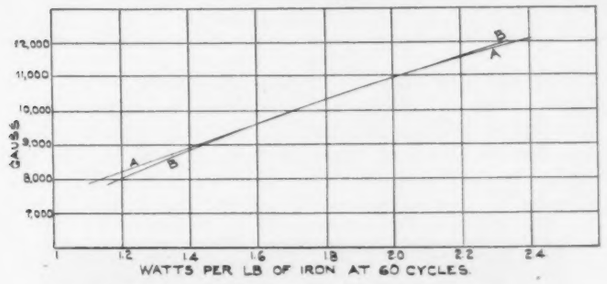
Then there are engineers who are up to the minute sufficiently to regard the high-class steel makers with more confidence. It certainly is consistent for the buyer to return the confidence of the maker who spends his time and money to better the art in which he is so interested. These more generous people keep the new product from starving to death.

To show that it is not necessary to change dies materially or expend money upon pattern changes in order to take advantage of new high-grade materials when offered is the purpose of the following argument:

I present in the accompanying illustration a set of two curves for consideration. Curve A is plotted from

the data contained in the literature of a prominent sheet-steel maker and is for 26-gage (0.01875 in.). It represents, I believe, his guaranty. Curve B has been obtained from data of another maker and represents his guaranty. It is for 29 U. S. standard gage (0.01406 in.).

The accompanying table gives data for the various



LOSS AT VARYING MAGNETIC DENSITY

gages concerning the percentage of iron in a given volume of laminated material for 0.001 in., 0.002 in. and 0.003 in. allowed per lamina for insulation, etc. The table also gives the number of laminas occupying 1 in. of built-up structure.

Most engineers regard the Epstein test as a proper criterion for the behavior of the steel in the machine. While the iron losses of the apparatus are usually higher than shown by the standard Epstein test, designers have a fair understanding of the reasons therefor, particularly as they apply to their own machines. The curves shown herewith have been based on data obtained by the Epstein method.

Consider a given magnetic circuit to be operated at 10,000 gauses (lines per sq. cm) at sixty cycles. Suppose the structure in question to contain solid steel

DATA ON IRON IN LAMINATED MATERIAL

Gage, U. S. Std.	Thickness, in Inches	PER CENT METAL FOR INSULATION PER LAMINA OF VARIOUS THICKNESSES, IN INCHES			NUMBER OF SHEETS PER INCH FOR INSULATION PER LAMINA OF VARIOUS THICKNESSES, IN INCHES		
		0.001	0.002	0.003	0.001	0.002	0.003
32	0.0102	91.0	83.7	77.2	90.0	82.5	76.0
30	0.0125	92.6	86.1	80.5	74.0	68.9	64.4
29	0.0141	93.4	87.6	82.5	66.4	62.3	58.7
28	0.0156	94.0	88.6	83.7	60.3	56.8	53.7
27	0.0172	94.5	89.6	85.0	55.0	52.2	49.5
26	0.0188	94.9	90.5	86.2	50.6	48.3	46.1
25	0.0219	95.6	91.8	88.0	43.7	42.0	40.3
24	0.0250	96.2	92.6	89.3	38.4	37.0	35.8

weighing 100 lb. If now the 29-gage steel of curve A be substituted, the weight will be decreased, but the gross volume will remain constant. If 0.002 in. be allowed for each lamina insulation, the weight, instead of being 100 lb., will be reduced to 87.6 lb., as shown by the accompanying table. Since the net iron is now only 87.6 per cent and the same total induction traverses it as in the case of the solid metal, the net magnetic density is increased from 10,000 gauses to 11,400 gausses. Curve A shows that at this density the 29-gage material has a core loss of 2.10 watts per lb. at sixty cycles. The structure will then have a total loss of 184 watts.

In view of the fact that the 26-gage material of curve B is slightly better than even the 29-gage of curve A, let us see what effect the substitution of it would have. A reference to the table will show that the 26-gage material with the 0.002-in. insulation allowance will net 90.5 lb. of metal in the chosen gross volume, or 90.5 per cent iron. Under this condition the net magnetic density will be 11,050 gausses, and curve B shows the loss to be 2.03 watts per lb. Thus the total for the 26-gage structure is 184 watts.

The losses being the same, the two cases may be compared for magnetic reluctances. It is giving the 26-gage material the worst of it to consider, for simplicity's sake, that the 26-gage and 29-gage materials are alike in their permeability characteristics. The chosen volume of the 26-gage material weighs 90.5 lb., while the 29-gage volume weighs only 87.6 lb., or 97 per cent of the net iron section of the former. Where the magnetic densities are high—say in the neighborhood of 20,000 gauses—the extra 3 per cent of metal may mean a reduction of 10 per cent or more in the magnetomotive force required to magnetize the volume.

Reference to the table will show that for the 0.002-in. insulation 62.3 punchings of 29-gage are required per inch of built-up volume, while only 48.3 are required of the 26-gage. Using the heavier gage, then, should easily increase the production of the punching shop (reckoning punchings by weight) by 25 per cent. Each 0.05 cent saved per pound of steel consumed represents a saving of $1 per ton.

The established difference in price between the 29-gage and the 26-gage materials is $3 per ton in favor of the heavier material. It is seen, therefore, that without changing the designs, by using the better material of curve B we increase the production of the punching shop by 25 per cent, reduce the varnish used for insulation, and, even though we do use 3 per cent more metal than before, we still save between $2 and $3 per ton on the raw material.

The fact of the situation is, however, that the average buyer would rather not change gages and make these savings. Of the two or three real dollars per ton saved he is not willing to give the steel maker one for his efforts, expensive research and backed-up guarantees. Even considering the punching-shop increase of capacity, he is not willing to change gages.

Follansbee, W. Va. JOHN G. HOMAN.

Co-operative Electrical Farming

To the Editors of the Electrical World:

SIRS:—I have noted with interest the article "Co-operative Electric Threshing by Iowa Farmers" in your issue of Jan. 24.

This is a most promising development and one especially gratifying to me, since I have so long advocated electric farming in the technical and general press, having been the pioneer in this country in the cause of electrified agriculture, besides pointing out in detail in my recent book, "Electricity for the Farm and Home," the benefits of co-operation in electric farming.

The group of Iowa farmers mentioned should, however, carry their co-operative operations very much further in order to realize the full benefits of various applications of electricity on the farm. One of the most notable advantages of such co-operative farming is electric plowing. The ownership of an electric plow involves entirely too large an investment for the average individual farmer, but its purchase by a group enables its benefits to be reaped by all.

Central-station companies would find it to their advantage to promote co-operative electric farming, since they will thereby establish better load-factors. Co-operative electric farming promises to be the mainstay of a large number of central stations in the next decade.

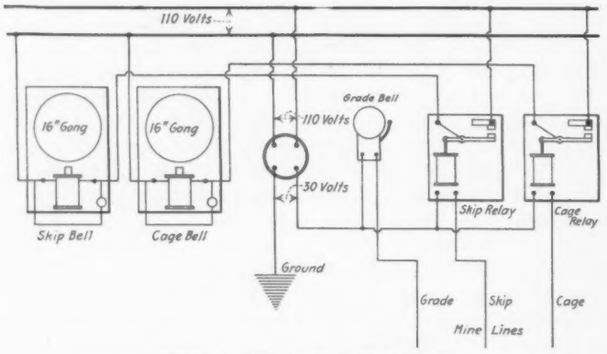
New York. FRANK KOESTER.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Alternating-Current Signal System for Mines

The alternating-current signal system illustrated herewith can be used satisfactorily in mines where direct-current systems have given trouble due to electrolysis. The bells are of the alternating-current sole-



SIGNAL SYSTEM FOR MINES

noid type and are operated by means of a relay from a 110-volt circuit. A small 110/30-volt transformer supplies low-potential energy for the operating circuit, one side of which is common and grounded while the other passes through the respective relays. The ungrounded side of the circuit consists of No. 4 bare copper wire supported on insulators. By grounding any wire its respective bell will ring. This system is used in the Penn Iron Mines in Michigan.

Remote-Controlled Valves for High-Pressure Fire-Protection System

In New York City, south of Houston Street and east of the Bowery, are two interlacing but independent

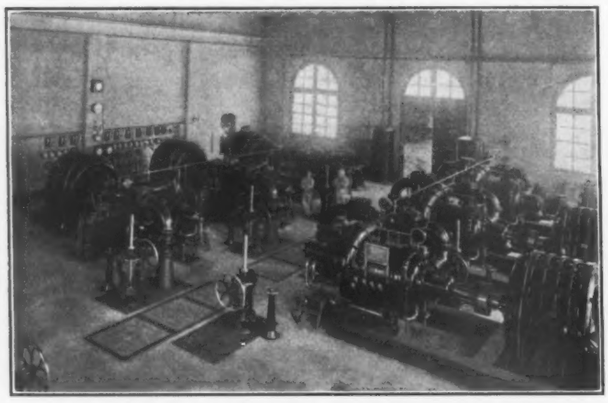


FIG. 1—ONE OF NEW YORK'S MOTOR-DRIVEN PUMPING STATIONS

high-pressure fire-protection systems which are now being connected at three points by remote-controlled motor-operated valves to permit more flexible and reliable operation. The valve-control apparatus is installed in the pumping stations so that if a break occurs in a water main, as indicated by the Venturi charts or pressure gages, the crippled section can be isolated in about one minute. One of the valves is an accessory to the duplex system and the other two are provided for the purpose of separating or uniting the two pumping dis-

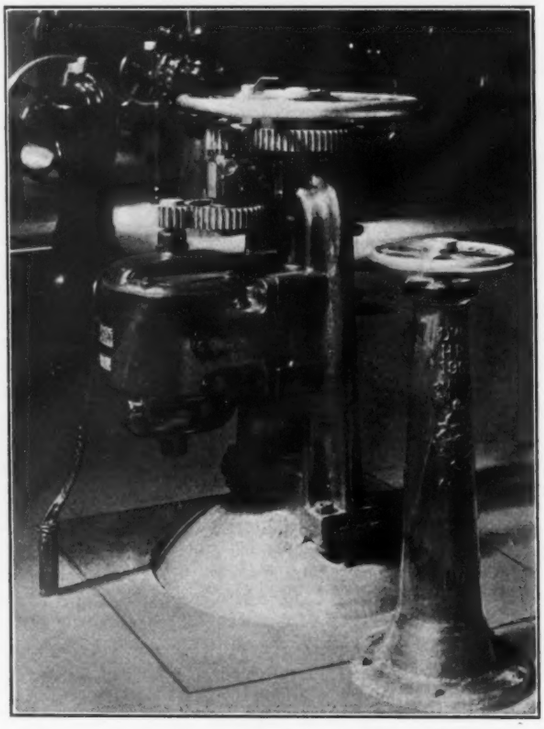


FIG. 2—MOTOR-OPERATED GATE VALVE IN HIGH-PRESSURE FIRE SYSTEM

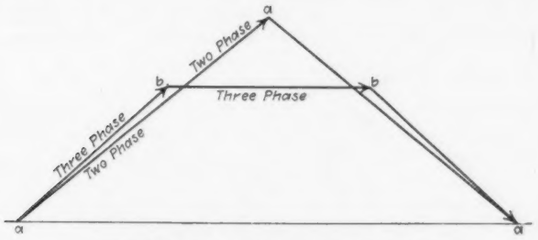
tricts. These valves also permit of supplying both systems from one pumping station when the other becomes inoperative. Each valve is operated by a 5-hp motor placed in a vault beneath the street, where an emergency control board is also installed. The pumping stations, of which there are two, are both motor-operated, energy being supplied by the New York Edison Company.

Converting an Operating Frequency Changer from Two-Phase to Three-Phase

When the Kansas City (Mo.) Electric Light Company began changing over its system from two-phase to three-phase operation the problem of rewinding frequency changers without purchasing additional units became a pressing one. Owing to load conditions on the sixty-cycle system which these machines were supplying it was impossible for the largest of them to be out of service a sufficient period of time to make the change in its coils. There were, however, times each day when the large machine was not on the lines.

A way out of the difficulty was suggested by Mr. R.

K. McMaster, electrical engineer for the company, and, acting upon his suggestion, a portion of the machine was changed each day until the conversion was complete. By the scheme adopted a single pair of poles was changed at a time, and as the three-phase coils were set in place end connections and jumpers were installed so that the new coils might form a part of the two-phase



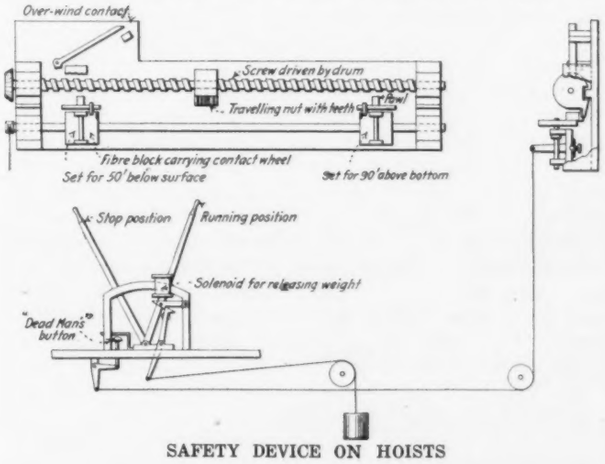
VECTORS FOR ONE PAIR OF POLES

winding delivering two-phase energy to the external circuit. From the vectors in the accompanying diagram showing the phase position of the generated emfs it will be seen that each pair of poles delivered approximately the same amount of energy as when the two-phase winding was in place.

Eight poles of the twenty-pole unit were changed during the first day and eight the second day. On the third day of the work the remaining four poles were changed and the jumper wires were removed, completing the job. During the intervening peak loads the machine was operated in parallel with the other frequency changers of the system, carrying its share of the two-phase load. When the change was complete the re-wound machine was thrown on the three-phase bus and it has since been operating without trouble.

Automatic Control of Hoist Motor

Illustrated herewith is a device which can be adapted to use on mine hoisting apparatus to limit the travel of the cage and to prevent too high acceleration or the overwinding of the hoisting cable. The mechanism consists of an endless screw along which travels a nut actuating three contactors (shown in the drawing) which in turn operate the drum brake and open the



SAFETY DEVICE ON HOISTS

clutch. A flyball governor for limiting the rate of acceleration is attached to the intermediate shaft connecting the mechanism with the hoisting drum.

Two of the contactors limit the travel of the hoisting cage while the third prevents overwinding of the cable. The travel-limit contactors may be rendered inoperative by turning the common shaft on which they are mounted through a small angle by pressing on a "dead-man's" floor push, located near the clutch and brake levers. Attached to the lever quadrant is a solenoid trip which when operated by the contactors causes a weight to throw both levers into the "stop" position. This last operation is entirely practicable, as these levers are only master controllers of the oil-operated brake and clutch apparatus.

This scheme of automatic control is being employed with satisfaction at the Penn Iron Mines, Vulcan, Mich.

Cost of Electric Riveting

Will you give me some information on the cost of riveting, using electricity to heat the rivets? J. S. K.

Below are printed data on the cost of riveting with Eveland electric riveters in which alternating-current energy is used only to heat the rivets, the heads being formed by a single manual operation. The figures are based on actual tests with rivets of ordinary length and represent only the cost of energy at 10 cents per kw-hr.

Rivet Diameter, In.	Energy Cost per 1000
0.25	$0.04 to $0.05
0.3125	0.08 to 0.10
0.375	0.12 to 0.14
0.5 to 0.625	0.20 to 0.25

Larger sizes can be riveted at a cost practically proportional to their volume. The labor cost is low with the electric riveter, as one man with a helper can do more work than two men and a forge attendant using pneumatic or other power apparatus.

Pole Fires Caused by Soot on Insulators

We are having an unusual amount of trouble on a section of 30,000-volt transmission line from poles and cross-arms burning. The line passes near a tin-plate factory which emits large quantities of dense smoke and acid fumes. A deposit has been collecting on the insulators for several years. Can the burn-outs be attributed to the smoke? E. E. L.

The deposit which you have noticed on the insulators is probably soot in the form of finely divided carbon. This coating furnishes a path to ground or between conductors, and the resulting leakage currents may be the cause of firing your poles. If the soot deposit is slow in forming, it ought to be possible to prevent repetition of the trouble by periodically cleaning the insulators with a portable compressed-air blower or by hand when the line is de-energized. In case the deposit forms rapidly, it may be necessary to protect the insulators with some sort of covering. On the Pacific Coast one company experienced considerable trouble from insulator break-downs due to the salt sea fog. The insulators were finally inclosed in fog boxes and no further trouble was had. It may be possible that the acid fumes which you mention are absorbed by the cross-arms when they are wet and the tendency to burn-outs increased. Some even more peculiar phenomena than this took place in the East recently where insulated conductors spanning a marsh were continually being eaten away and disintegrated. The trouble was finally traced to acid fumes arising from the stagnant water of the marsh. As glass is more hygroscopic than porcelain, there is more tendency for dust and soot to collect on the former. According to tests recently reported in these columns, dry insulators coated with dirt and soot withstood 75 per cent of their normal break-down voltage for half an hour before failing, whereas the same sooty insulators in a damp atmosphere broke down in a much shorter time because of moisture collected on the surface deposit.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Lifting Magnets.—Karl Metzler.—A mathematical paper on the design of bell-shaped lifting magnets with respect to rise of temperature and minimum cost of material. The cost of material of lifting magnets becomes a minimum if the price of the iron shell equals the price of the winding. The relation $T = 630\ L \div O$ (where T is the rise of temperature of the winding, L the power required for excitation measured in watts, and O the total surface of the coil in square centimeters) permits determining the iron cross-section in such a way that the weight of the winding becomes a maximum. The total ampere-turns obtained from this maximum weight of winding are then separated into iron ampere-turns and air ampere-turns on the supposition of different inductions in the iron. For the final design those values for which the tractive force becomes a maximum are selected from the table. This method is especially suitable for comparative calculations for different winding constructions.—*Elek. u. Masch.* (Vienna), Feb. 22, 1914.

Brush Holders.—J. O. Girdlestone.—An illustrated article giving some details of a new brush-holder construction.—London *Elec. Review*, Jan. 9, 1914.

Lamps and Lighting

Half-Watt Tungsten Lamp.—H. Lux.—An account of

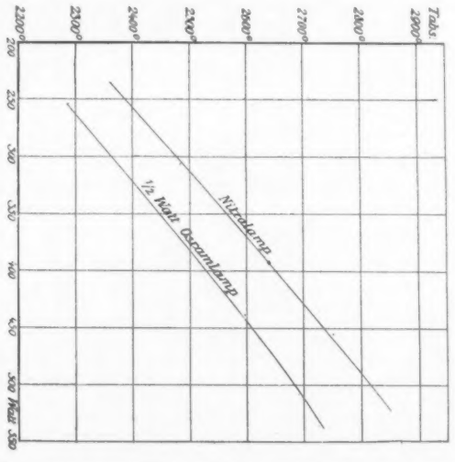


FIG. 1—TEMPERATURE-ENERGY CURVES OF NITRA AND ORDINARY TUNGSTEN LAMPS

a long and elaborate series of tests of a 1000-cp "nitra lamp" for 110 volts and a 1000-cp "half-watt osram lamp" for 115 volts. The photometric curves of the two lamps are given. For the nitra lamp the mean spherical candle-power equals 0.857 time the horizontal candle-power and the mean lower hemispherical candle-power equals 0.912 time the horizontal candle-power. For the half-watt osram lamp the mean spherical candle-power equals 0.832 time the horizontal candle-power and the mean lower hemispherical candle-power equals 0.904 time the horizontal candle-power. Various tables are

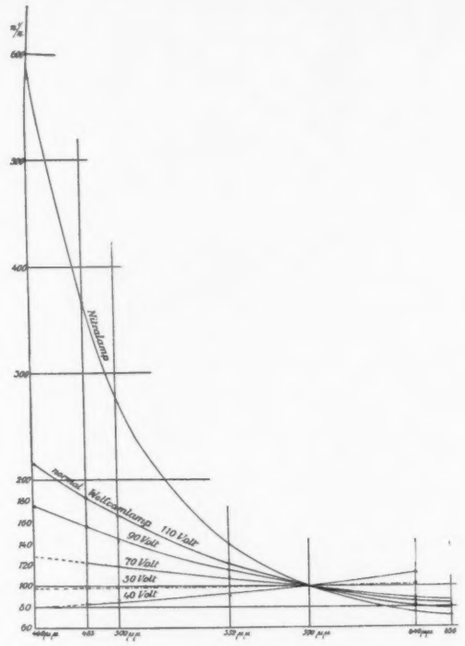


FIG. 2—SPECTRAL COMPOSITION OF LIGHT FROM NITRA AND ORDINARY TUNGSTEN LAMPS

given of the specific consumption of the lamps and of the ratio of light radiation to power supplied. Some of the principal figures are collected in the table reprinted. Fig. 1 gives the curves of the temperatures of the nitra lamp and the half-watt osram lamp as a function of the watt consumption. Fig. 2 gives the spectral composition of the light of the nitra lamp and of ordinary tungsten lamps. The highest curve is the curve of the nitra lamp and the five lower curves relate to ordinary tungsten lamps at 110, 90, 70, 50 and 40 volts respectively. The abscissas are wave-lengths. The diagram shows clearly how much stronger the nitra lamp is in

SPECIFIC CONSUMPTION OF LAMPS AND RATIO OF LIGHT RADIATION

	Watts per Mean Spherical Hefner Cp					Watts per Mean Lower Hemispherical Hefner Cp					Ratio of Light Radiation to Power Supply in Per Cent				
Volts	70	90	100	110	115	70	90	100	110	115	70	90	100	110	115
Nitra.....	1.486	0.836	0.666	0.567	.....	1.396	0.785	0.626	0.533	.....	2.06	3.11	4.09	4.82	....
Osram.....	2.268	1.206	0.919	0.770	0.686	2.084	1.111	0.846	0.709	0.632	1.39	2.18	2.86	3.61	3.84

blue rays than are ordinary tungsten lamps. For this reason the nitra lamp gives a much whiter light than the ordinary tungsten lamp. But it is still reddish compared with sunlight. By inclosing the lamp in a blue-green globe a light is obtained which is as nearly equal to diffused daylight as may be desired for all purposes where exact color distinction is necessary.—*Zeit. f. Beleucht.*, Jan. 20 and 30, 1914.

Ductile-Filament Tungsten Lamps.—An illustrated description of the "ferrowatt" lamp, the characteristic feature of which is its relatively small size due to the use of a tungsten filament in the form of a spiral, the filament being arranged chiefly in a horizontal position. The maximum candle-power is obtained vertically downward in the direction of the lamp's axis. The 220-volt, 25-cp lamp has a largest diameter of 64 mm (2½ in.) and a height (without the socket) of 64 mm.—*Elek. Zeit.*, Feb. 19, 1914.

Electric Incandescent Lighting Versus Gas.—M. SCHOLZ.—The author discusses to what extent the new "half-watt" tungsten lamp is likely to hurt the gas-lighting industry. He concludes that even with the new lamp and with the relatively low tariff charged in Berlin for public electric lighting the lighting of streets by electricity is more expensive than the use of gas. The same result is claimed for the lighting of store windows, etc. The final conclusion is that even the new half-watt lamp has not yet overcome the economical handicap enjoyed by gas.—*Zeit. f. Beleucht.*, Feb. 10, 1914.

Carbon-Cobalt Filament.—A note on a recent British patent (No. 16,481, 1913) of C. Kanazawa. A raw filament is prepared from a cellulose solution containing cobalt oxide and manganese sulphate in a solution of zinc chloride. This filament is subjected to a white heat in a crucible with graphite under vacuum for more than twenty hours. It is said that the filament is strong, efficient, has a long life and is not affected by vibration.—London *Elec. Eng'ing*, Feb. 19, 1914.

Generation, Transmission and Distribution

Traveling Waves.—LUDWIG BINDER.—The conclusion of his article, illustrated by diagrams, in which the author gives a hydrodynamic analogy of electric waves traveling along a line. The following special cases are discussed in the present instalment: Reflection of a traveling wave from the end of a line; reflection at a switch; reflection of a discharge wave; reaction of a switching operation upon a machine; entrance of a discharge wave into a machine; transition of a traveling wave from one line into another line of different characteristics, and effect of a short-circuit. While the principal part of the article deals with direct current, a few notes on alternating current are added.—*Elek. Zeit.*, Feb. 19, 1914.

Mechanical Refrigeration.—J. MACINTIRE.—A second article of his illustrated serial on the physico-chemical principles of mechanical refrigeration. In the present instalment the author discusses the compression refrigeration cycle.—*Metall. and Chem. Eng'ing*, March, 1914.

Traction

Electric Locomotives.—HANS ENGEL.—A description of a new type of locomotive constructed for the electric line from St. Moritz to Schuls, with a branch to Samaden-Pontresina, and known as the Rhaetian railway. It employs seventeen-cycle, single-phase energy at a pressure of 10,000 volts to 11,000 volts. The locomotive must be capable of drawing a train having a total maximum weight of 200 tons, and it was particularly specified that a train having a total weight of 180 tons must be able to start on the gradient of 1 in 40 and attain a speed of 17.5 miles per hour in fifty-two seconds. Further, these trains must travel backward and forward over the entire line from St. Moritz to Schuls four times consecutively—i. e., a total distance of 285 miles—without the electrical equipment becoming excessively heated. The maximum speed is 27.5 miles per hour. The brake specified was of the Hardy vacuum type. The drive is accomplished by two motors, each having an hourly rating of 350 hp. Both motors are connected according to the method known as the double-feed system. On starting the rotor is short-circuited.—*A. E. G. Journal;* abstracted in London *Electrician*, Feb. 20, 1914.

Mountain Railway.—The conclusion of the long, detailed and profusely illustrated description of the Lötschberg railway. In the present instalment the power station and line equipment are dealt with.—London *Electrician*, Feb. 20, 1914.

Installations, Systems and Appliances

British Statistical Tables.—A table of 332 colonial electricity supply stations (in Canada, South Africa, Australia, etc.), giving names of companies, officials, details of equipment, etc. A second table gives a list of 190 supply stations in other countries than Great Britain, a third list gives data of forty colonial electric tramways and a fourth presents data of forty-seven tramway systems in other countries than Great Britain. —Supplement to London *Electrician*, Feb. 20, 1914.

Electrical Industry in France.—M. SOUBRIER.—An article on the lessons of the exhibition in Ghent, 1913. The author refers to the poor showing of France among other countries in the development of electrical export trade and finds a remedy in a complete reorganization of the professional technical training system.—*La Lumière Elec.*, Feb. 7, 1914.

Wires, Wiring and Conduits

Spacing Distances.—GINO REBORE.—An article on the safe distances which should be maintained between conductors and earth and between conductors and walls in wiring installations.—*Atti dell' Assoc. Elettrot. Italiana*, No. 3, 1913; *La Lumière Elec.*, Jan. 31, 1914.

Cables.—J. B. SPARKS.—An article giving comparative tables which permit a rapid comparison of the cost of paper-insulated aluminum cables with copper cables for different prices of aluminum and copper within white limits.—London *Elec. Review*, Jan. 9, 1914; *La Lumière Elec.*, Feb. 14, 1914.

Electrophysics and Magnetism

Electric Resistivity of Brass.—E. F. NORTHRUP.—An article illustrated by diagrams giving the results of an experimental determination of the resistivity of brass from 20 deg. C. to 1100 deg. C. The ratio of the electric resistivity in the liquid condition at the melting point to the electric resistivity in solid condition at the same temperature is 2.37.—*Metall. and Chem. Eng'ing*, March, 1914.

Suppression of the Photoelectric Effect.—K. FREDENHAGEN AND HANS KÜSTNER.—An account of an experimental investigation which thus far has been restricted to zinc, the investigation of other metallic surfaces being still in progress. The results obtained may be summarized as follows: (1) No measurable photoelectric effect can be obtained with pure zinc surfaces when all traces of reactive gases have been removed. That is, the photoelectric effect is less than one-thousandth part of the value found under ordinary experimental conditions. (2) The "fatigue" which occurs in the presence of reactive gases can be accounted for by the reaction with absorbed gases. The "recovery" is explained by the diffusion of reactive gases toward the zinc, whereby the velocity of the reaction, and consequently

the strength of the photoelectric current, are conditioned by the concentration of the reactive gases at the zinc surface. The time variation of the photoelectric current can be changed multifariously by suitable combinations of the two processes constituting fatigue and recovery. (3) So long as ionization by collision does not enter as a factor, the pressure of neutral gases has no influence on the magnitude of the photoelectric effect.—*Physik. Zeit.*, No. 2, February, 1914; abstracted in the *Amer. Jour. Science*, March, 1914.

Electrochemistry and Batteries

Electrometallurgy of Iron and Steel.—WOOLSEY MCA. JOHNSON.—After some remarks on iron ore reduction in the electric furnace the author takes up the electrometallurgy of steel for the following three purposes—special steel or alloy steel making, steel castings in foundry work, and electric refining of molten steel for tonnage products. Some other smaller applications of the electric furnace in the metallurgy of steel are also discussed.—*Metall. and Chem. Eng'ng*, March, 1914.

Electric Laboratory Furnace.—ZAY JEFFRIES.—An illustrated article on the "gran-annular" electric furnace. The name implies "granular" because the electric resistor is in the form of grains and "annular" because the grains occupy a space in the furnace of the shape of a hollow cylinder. A description of this furnace is given and the results obtained with kryptol, granular carbon and granular graphite as resistor material are given. A comparison is made with a platinum-wire furnace and notes are added on operation, control of temperature and various uses.—*Metall. and Chem. Eng'ing*, March, 1914.

Ductile Tungsten.—R. W. MOORE.—A paper describing the different steps in reducing tungsten from its ore and in changing metallic tungsten from the brittle to the ductile state.—*Metall. and Chem. Eng'ing*, March, 1914.

Units, Measurements and Instruments

Series Dicharge Tubes.—H. GREINACHER.—If a horn lightning arrester is connected to the poles of a high-tension transformer, an arc is obtained which travels upward between the two horns, is then extinguished. a new arc is formed at the bottom, it in turn travels upward, etc. By taking a photograph of the phenomenon

FIG. 3—SERIES DISCHARGE TUBES

it is seen that the arc consists of series of discharges traveling upward. This fact can be made visible directly to the eye by producing the discharge in a vacuum. In this case no real arc is obtained, but only a so-called brush discharge. Each partial discharge of the transformer produces blue brush discharge streak (negative) and on the opposite wire a point of red light (the so-called anode light). Fig. 4 shows the discharge obtained with a tube for making such experiments, as shown in Fig. 3, which can be evacuated at will. For a certain degree of vacuum the phenomenon is most effective. These tubes may also be fitted with different gases like nitrogen, carbon dioxide, helium, etc. These tubes can be used for the following purposes: First, the

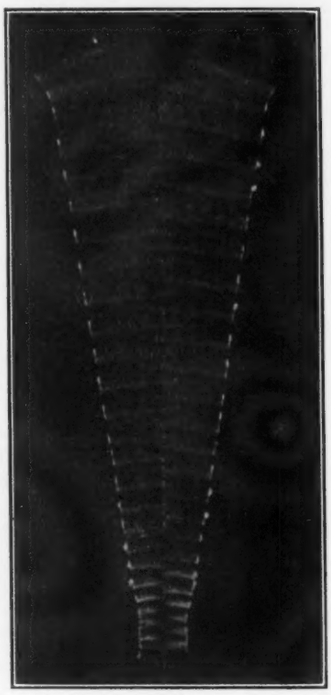


FIG. 4—HIGH-TENSION DISCHARGE BETWEEN HORNS IN A VACUUM

character of the current can be determined, as the phenomenon is quite different for alternating current, continuous current and intermittent direct current. Any distortion of an alternating current, for instance, by electrolytic valves, can be seen by means of the discharge tube. Secondly, the tubes show the way in which direct-current interrupters operate. Third, short-time intervals can be easily determined by means of such tubes. The time interval between two brush streaks for alternating current of fifty periods is 0.01 second. If, for instance, the period of exposition of a camera shutter is to be determined, the picture of the series discharges on the plate is counted; if there are five streaks during the operation of the shutter, the exposure is 0.05 second.—*Elek. Zeit.*, Feb. 19, 1914.

Magnetic Tests of Cast Steel and Cast Iron.—H. SCHÜBBE.—An illustrated article in which the author first describes the ring method and discusses the calibration of the mirror galvanometer and the determination of the mean magnetization curve. He then takes up the yoke method, which is far more convenient, and shows how to apply the correction for the air which is inclosed between the rod and the secondary winding, also the correction for the magnetization of the yoke and the correction for the air inclosed in the contact surface.—*Elek. u. Masch.* (Vienna), Feb. 22, 1914.

Induction Meters.—MANNE SIEGBAHN.—An article illustrated by diagrams in which the author gives a theory of three-phase induction meters (Ferraris meters) on the basis of Maxwell's fundamental equations. For this purpose these equations are written in the form of polar co-ordinates and are essentially simplified for the special conditions of the problem.—*Elek. Zeit.*, Feb. 19, 1914.

Telegraphy, Telephony and Signals

Wheatstone Automatic Telegraph System.—RICARDO LOPEZ.—An illustrated description of a new method which the author has invented for perforating the paper strips used for the automatic transmission of telegraph signals by the Wheatstone transmitter. The work of perforation is thereby much simplified and can be effected without any other change in the electrical connections or any further training on the part of the operators.—London *Electrician*, Feb. 20, 1914.

Wireless Transmitter.—A. S. BLATTERMAN.—The conclusion of his mathematical paper, in which the author describes in a general way how to calculate the design of a wireless telegraph station. In the present instalment the design of a 5-kw station is given as an example.—London *Electrician*, Feb. 20, 1914.

Wireless Telegraphy.—P. BRENOT.—A review of the present status of receiving stations for wireless telegraphy. The author gives details of the receiving antenna, the connections at the receiving stations, constructions of receivers and different types of detectors. —*La Lumière Elec.*, Feb. 14, 1914.

Book Reviews

TASCHENBUCH FÜR MONTEURE ELEKTRISCHER BELEUCHTUNGSANLAGEN. By Gottlob Lux and Dr. C. Michalke; revised by Freiherr von Gaisberg. 284 pages, 210 illus. Munich: R. Oldenbourg.

A very practical pocket-book intended for the use of electric-light workers. It contains information as to the nature, construction, mode of operation and maintenance of electric machinery, apparatus and plant, to enable the operator to carry on his duties the more intelligently. The subjects treated of may be judged from the following list of main sections: General preliminaries; machinery; generators; motors; motor-generators and transformers; installation and maintenance; tests for defects; storage batteries; instruments; grounding; arc lamps; vapor lamps; incandescent lamps; conductors, and rules and precautions. The book is written in clear and simple language with plenty of illustrations and diagrams, some of which are rather rough in appearance. There are few tables and fewer formulas. The volume will interest electric-lighting engineers who wish to know what is published in Germany for the use of central-station assistants.

A READER OF SCIENTIFIC AND TECHNICAL SPANISH. With vocabulary and notes. By Cornelius De Witt Willcox. New York: Sturgis & Walton. 590 pages. Price, $1.75 net.

An excellent textbook of contemporaneous Spanish scientific and technical language intended for the use of English-speaking students already familiar with elementary Spanish and desirous of becoming acquainted with scientific and technological Spanish. The book is divided into nineteen chapters relating to the following topics: Physics, chemistry, the conservation of modern explosives, the utilization of hydraulic power, steam, applications of compressed air, steam turbines, electric energy transmission, mines, bridges, railways, surveying, topography, geography, automobiles, aeronautics, submarines, and the battle of Santiago de Cuba. A good vocabulary index completes the book. The particular series of subjects dealt with is essentially that in which the student of military and naval sciences is most interested. Nevertheless, the treatment is sufficiently broad to invite the interest of students of engineering generally. The volume will be useful to technological colleges and to students intending to take up technical work in Spanish-speaking countries.

CHRONIQUE ILLUSTRÉE DU CONCOURS INTERNATIONAL DE TÉLÉGRAPHIE PRACTIQUE; Turin, 1911. Rome, Italy: Ministero delle Poste e dei Telegrafi. Edited by Ferdinando Geronimi. 186 pages, with appendixes of 150 pages, illus.

A handsomely bound and finely illustrated souvenir volume commemorating the International Congress of Practical Telegraphy at Turin in 1911 in conjunction with the Turin exhibition of that year. The volume has been printed mainly in French, although the congress was on Italian soil, in order thereby to be more generally acceptable and readable. Along with the numerous social events described and photographed were a number of Morse and Baudot practical message tests with medals and prizes for speed and accuracy in transmission as awarded by an international jury. The book well commemorates the event which it signalizes.

DEUTSCHER KALENDER FÜR ELEKTROTECHNIKER. 1914. Founded by F. Uppenborn; new edition amplified by G. Dettmar. In two parts. Part I, 648 pages, 229 illus.; Part II, 348 pages, 154 illus.

A carefully worked-out pocket-book for the electrical engineer in two small volumes. The first is in a leatheroid cover for the pocket and the second is in unprotected paper for the bookshelf. Volume I is divided into fourteen sections, relating to the following subjects: Conversion tables; units; magnetism; electricity; measurements; electric machines; transformers; apparatus; generating and distributing stations; electric lighting; motors; miscellaneous public utilities; rules; precautions. A calendar, for notes and engagements, brings up the rear. Volume II is likewise divided into fourteen sections as follows: Electric railways; electric vehicles; telephony; telegraphy; fire annunciators; signal telegraphs; railway block signaling; electric mine firing; electric blocks; lightning protectors; electrochemistry; physics; mathematics; technical tables. The two little volumes contain jointly a very large amount of electrical engineering data and information that will recommend them to those acquainted with the German language and who are interested in European technical practice.

FREILEITUNGSBAU-ORTSNETZBAU. Ein Leitfaden für Montage- und Projektierungs- Ingenieure Betriebsleiter und Verwaltungsamte. By A. Kapper. 351 illus., 2 tables. Munich and Berlin: R. Oldenbourg. Price, 13 marks.

A very practical engineering textbook and reference book on the construction of poles, masts and other structures for the support of overhead conductors. The book is clearly written and well illustrated. Numerous numerical examples are introduced to indicate the applications of the formulas. The twenty-seven chapters of the book relate to the following topics: Introduction; conducting materials; sag and tension; calculation of supports; stability of poles; bedplate stresses; anchoring; concrete foundations; constructing work; insulators; insulator supports; wire supports; joints; arrangement of conductors; grounding; crossovers; pole erecting; wire erecting; overhead transmission; instruments used in line construction; design; economic spans; economics of overhead construction; distributing conductors; contracts; tools; regulations. From the standpoint of engineering construction for overhead lines of all kinds, the book is one of the most thorough and complete that we have seen. It will recommend itself to all constructing engineers and students of line construction acquainted with the German language.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Chandelier Pull Switch

A pull switch which can be attached to the bottom of a chandelier for controlling the lamps installed thereon is being manufactured by the Bryant Electric Company, Bridgeport, Conn. The device is made in two

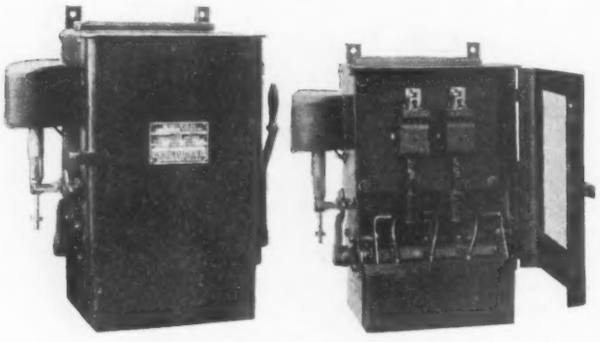
PULL SWITCH

sizes, one known as the standard "New Wrinkle" switch and the other as the electrolier or "Wrinklet" switch. Both types are provided with a 0.125-in. cap and 10 ft. of black linen cord. This cord can be cut off to the desired length, depending upon the height of the ceiling and of the chandelier. A beaded chain takes the wear through the nipple on the bottom of the switch.

Starting Switch for Alternating-Current Motors

The switch shown herewith was designed for throwing directly upon the line squirrel-cage induction motors rated at 7.5 hp or less. The shaft carrying the switch contacts extends through both sides of the inclosing case, the lever for its operation being attached to the right end, while a locking arm is attached to the left end.

The operating lever is held in the "off" position by strong springs. The mechanism is so designed that the



INCLOSED STARTING SWITCH

lever cannot be moved to the running position until it has first been thrown to the starting position. The switch contacts are oil-immersed, thus utilizing the oil break to minimize sparking and insure long life. The oil tank can be easily removed for inspection or repair of the switch.

The switch is provided with a low-voltage release coil which shuts the motor down in case of failure of voltage. The magnet coil being de-energized, its core drops and strikes the lever which engages the locking arm and holds the switch closed in the running position, thus tripping the switch and permitting the starting lever to return instantly to the "off" position. This low-voltage release coil is totally inclosed.

Overload relays, which are designed to permit a wide range of adjustment, protect the motor from overloads and prevent it from running single-phase. These relays are mounted inside the inclosing case. If it is desired to stop the motor from remote points, push-button stations may be wired into the low-voltage-release circuit so that when the button is pressed this circuit is opened and the switch tripped in the same manner as when the voltage fails.

This motor-starting switch above described is manufactured by the General Electric Company, Schenectady, N. Y.

Pressed-Steel Transformer Case

A transformer case for distributing transformers recently developed is of pressed steel, the material used being blue-annealed planished steel plate. The principal advance in design claimed for the new case is that it is much lighter and stronger than the ordinary cast-iron cases that have been in use for the past twenty-five years.

The reduction in weight of transformers is important to the central station, because the cost of handling transformers is a definite, appreciable item of expense to which little attention seems to have been paid heretofore. Transformers are really a tonnage material when considering the handling expense, the lightest and smallest size weighing at least 100 lb. and the medium and larger sizes weighing up to 3000 lb. each for the pole-type sizes. The handling of distributing transformers is necessarily done by the line-crew with "hand-power" and "man-power," which is higher in cost than "horse-power." An average saving in the total transformer weight of 30 per cent claimed by the manufacturers of the new pressed-steel case transformer means practically an average saving of 30 per cent in freight, and since transformers run into considerable weight, the cost for freight is an item of expense which the buyer of distributing transformers must pay directly or indirectly. While it is difficult to get accurate central-station costs for the handling of such heavy material as transformers, fairly close estimates are made, and such estimates show that on 10,000 lb. of transformers shipped 500 miles the freight, cartage, loading, unloading, warehousing, installing, etc., costs about $110. Thus a 30 per cent decrease in weight saves $33.

The percentage of weight reduction (30 per cent) is substantial enough to result in other practical benefits to the central station in permitting larger transformers to be mounted on poles with the same pole-strain safety factor, or permits the use of smaller poles for given transformer sizes.

Reduction in weight with the additional advantage of

strength is, of course, very desirable. It is claimed that the new pressed-steel case is not only lighter in weight but much stronger than cast iron, so that the new case will stand up even better to the every-day wear and tear, rough handling in transit, accidental bumps and jars, such as sometimes happen when a transformer is dropped from a pole or wagon. It is said that in tests made recently thirteen blows with a sledge failed to show any injury, except slight indentation of the pressed steel, whereas the ordinary cast-iron case was cracked with the first blow and shattered completely with the second blow. The common cast-iron case will let oil leak through, owing to seepage through the porous material, unless it is carefully japanned, and where the cast iron is imperfect or thin hot transformer oil will seep through the metal and drip. Pressed steel, because of its density and non-porous structure, eliminates the possibility of oil seepage. It

TRANSFORMER WITH PRESSED-STEEL CASE

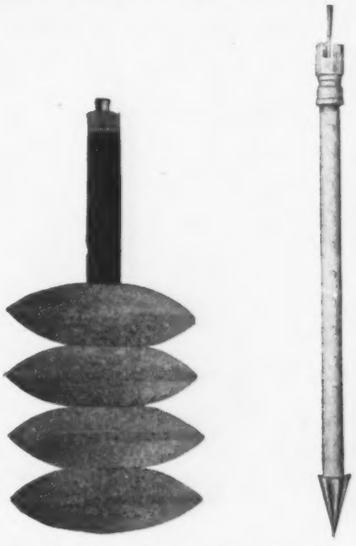
is said that tests of the pressed-steel case which has been under development for several years have been thoroughly carried out by its originator, the Pittsburgh Transformer Company, Pittsburgh.

Grounding Device

The Lord Manufacturing Company, Brooklyn, N. Y., has developed a device for grounding which is made of porous material having an affinity with moisture. Two kinds of these "hydrogrounds" are made, one being of the disk type shown in Fig. 1 and the other of the driving type shown in Fig. 2. In the former four parts of the element in the form of ovoids are mounted in series on a central metallic conducting medium. A large surface contact is thus provided. The diameter of each ovoid is 6 in. An insulated metal stem extends above the top ovoid. The end of the stem is threaded and may be supplied with a coupling into which can be secured an extension. This type is furnished in two lengths, one being 13.5 in. long with a stem extending 6.125 in. above the ovoids and the other 6 ft. 2.125 in. long with a stem 5 ft. 7.625 in. above the ovoids. A lug is provided at the tip of the stem into which copper may be soldered.

In the drive type the element is inclosed in a perforated iron sheath one end of which is fitted with an iron cone and the opposite end with a reducing bushing and a driving cap. A No. 4 B. & S. copper wire is sealed into the center of the element for the entire length of the sheath and extends beyond the driving cap. Metallic contact is made between this conductor and the sheath. The cap is slotted so that the conductor may be protected from damage during driving. To this wire an extension wire may be joined if the pipe extension is not employed.

These grounding devices should be set deep in the



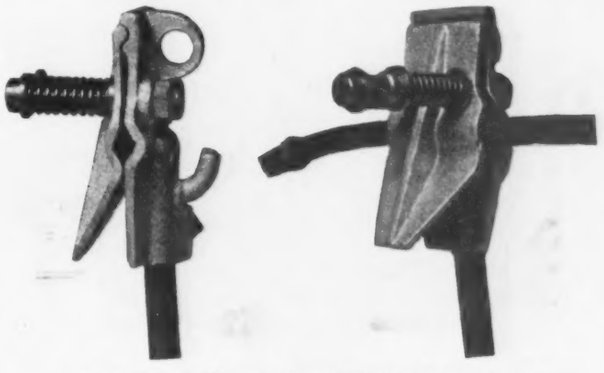
FIGS. 1 AND 2—DISK TYPE AND DRIVE TYPE

earth, the depth depending on the character of the soil and the general contour of the earth. It is advisable also to soak the earth surrounding the device with a strong brine.

Transmission-Line Clamp

A clamp for grounding transmission and pole lines of any description has been developed and is being placed on the market by Messrs. Hickey & Schneider, 227 Fulton Street, New York. The clamp may also be used for connecting two lines together when one or both of the lines are alive, for connecting transformers of a bank to their respective buses, as a substitute for pole-disconnecting switches and as a jumper between conductors of tower lines of two or more conductors.

The clamp, which is shown herewith, is made of two brass castings, the front flap and the rear flap. The



FIGS. 1 AND 2—TRANSMISSION-LINE CLAMP

rear flap has an eye at the top and a hook at the bottom with a set screw underneath. The eye at the top is provided for placing the clamp on a live line by means of a switch stick. When placed in position it balances itself nicely and can be snapped onto the conductor by hooking the switch stick in the hook and pulling downward. The set screw holds the wire lead in the clamp.

The bolts and springs of the clamp are made entirely of brass, thus eliminating all possibility of rust from exposure to the weather. The clamp may be removed from the line by placing the switch stick in the eye and pushing upward. In a test made on one of these clamps it was found that the device carried over 200 amp for two hours with a rise in temperature of only 5 deg.

Graphic Meters

Continuous-writing curve-drawing instruments for measuring electrical quantities such as volts, amperes, watts, etc., are being placed on the market by the Esterline Company, Indianapolis, Ind. Electric speed recorders, service recorders, pyrometers and graphic counters are also included among these devices.

These meters are available as switchboard rear-connected, wall or front-connected, and portable instruments. Their general construction is the same with the exception of the style of the case and the method of making connections.

The direct-writing type method is employed, the pen being in contact with the paper at all times. The pressure of the pen on the paper is regulated by a counterweight adjusted to hold the stylus on the paper with minimum friction.

An eight-day jewel-bearing balance-wheel clock is used. It is provided with two driving springs and a third spring which operates the re-rolling device for winding up the finished chart. On some types the reroll is omitted and the finished record is allowed to be fed out through a slot in the bottom of the case. Different combinations of gears are supplied so that five chart feeds, 0.75 in., 1.5 in., 3 in., 6 in. and 12 in. per hour, may be obtained on any clock by putting on the proper gears. For furnishing rapid chart feeds a special attachment permits the chart feed to be changed instantly from a given number of inches per hour to the same number of inches per minute.

The meter elements are assembled as a unit and may be removed from the instrument without dismantling.

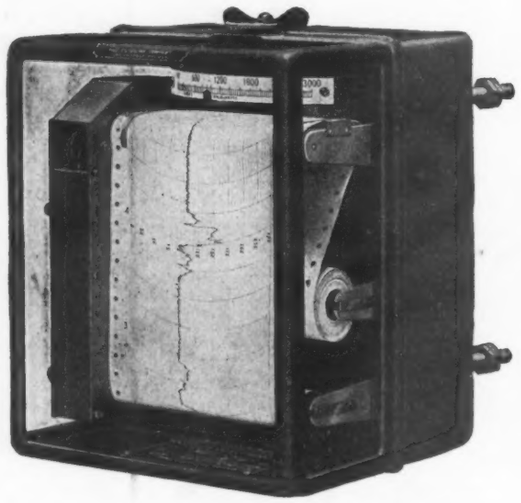


FIG. 1—PORTABLE METER WITH ALUMINUM CASE

For direct-current ammeters and voltmeters a powerful D'Arsonval permanent-magnet-type movement is used. For direct-current and alternating-current wattmeters, alternating-current voltmeters and ammeters, dynamometer construction is employed. No iron is used in the magnetic fields of the dynamometer movements. The armature shaft of the meter element has a bracket which carries pivots in which the pointer carrying the pen rests.

Tape record charts 6 in. wide with a ruled portion 4.5 in. wide are used. The time divisions are in the form of arcs ruled across the paper 0.75 in. apart. Range numbers are provided across the chart to facilitate the interpretation of the curves. The record charts

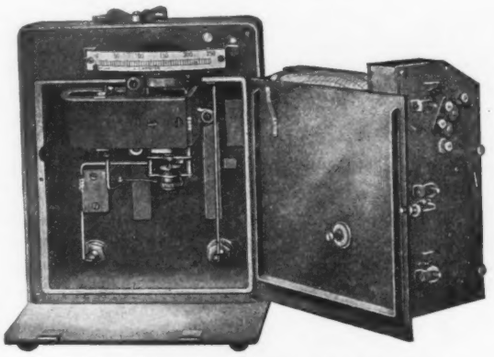


FIG. 2—METER WITH CLOCK DOOR OPEN

are of sufficient length to last two weeks each at 3 in. per hour.

The alternating-current instruments have adjustable damping devices consisting of rotating vanes immersed in small cups containing oil or other viscous liquid. The amount of damping is varied by adjusting the height of the cup, the quantity of oil or the quality of the liquid.

The energy consumption of the instruments themselves is so low that they may be operated from shunts or transformers already installed. Voltmeters and wattmeters require from 4 watts to 5 watts for each voltage element subject to a pressure of 110 volts. Direct-current ammeters consisting of millivoltmeters and shunts require only about 0.3 amp. Owing to the direct-writing construction, no extra control circuits are made use of.

Fig. 1 shows a portable meter with an aluminum case. Fig. 2 shows a portable meter with the clock door open.

Electric Passenger Cars at Boston Automobile Show

The twelfth annual automobile show at Boston, Mass., was opened in the Mechanics' Building March 7, to extend through March 14, pleasure cars only being exhibited. Commercial cars will be displayed at another show from March 17 to 21, inclusive. Fifty thousand persons visited the show on the opening night, breaking all records of attendance. The decorations were unusually elaborate. Some of the new products shown at Boston, which were not exhibited at either the New York or Chicago salons, are described in the following paragraphs:

S. R. Bailey & Company, Inc., Boston, Mass., featured an electric roadster seating four passengers, and also a new cabriolet or convertible roadster seating two persons. Its wheelbase is 132 in. and its length over all is 167 in. Sixty cells of Edison A-6 battery are carried in the spaces under the front hood and beneath the floor. The weight of the car is 3100 lb. with standard battery. A feature of the cabriolet lies in the design of the top to facilitate housing the passenger during winter and converting the machine into an open car in summer.

The Waverley Company, Indianapolis, Ind., exhibited a new front-and-rear drive brougham with copyrighted body design and a seating capacity for four. The overall length of the car is 139 in. and its width 66 in. The

wheelbase is 106 in. and the inside length, glass to glass, is 67 in. The body design includes a curved drop sill bringing the floor within easy reach of the ground. Separate steering and controller levers and a separate set of brake levers are provided at the rear seat. By the use of a sliding and folding chair construction increased floor space is made available when not more than three passengers are to be carried.

Other exhibitors were the Century Electric Car Company, Detroit, Mich.; W. L. Russell Company, Boston, "Buffalo" electrics; D. C. Tiffany Company, Boston, "Ohio" electrics; Anderson Electric Car Company, Detroit, Mich., "Detroit" electrics; Peerless Motor Car Company, Rauch & Lang electrics; Standard Electric Car Company; W. H. Stevens, Boston; American Storage Battery Company, Boston; Burn-Boston Battery Company, Boston; Holtzer-Cabot Electric Company, Brookline, Mass.; Philadelphia Storage Battery Company, Philadelphia, Pa.; Van Dorn Electric Tool Company, Boston; Columbus Buggy Company, Columbus, Ohio; Herbert S. Potter, Boston; Edison Storage Battery Company, Orange, N. J., and H. W. Johns-Manville Company, Boston.

1500-Volt Direct-Current Locomotives

The Piedmont & Northern Lines, Charlotte, N. C., are placing in service six new 1500-volt direct-current electric locomotives on the Greenville, Spartanburg & Anderson division of their system for heavy freight traffic. Each of these locomotives weighs 65.5 tons, all the weight being on the drivers. The cabs are of the box type, extending nearly the entire length of the underframe.

Each locomotive has four box-frame, commutating-pole motors, which at their normal rating, operating at 1500 volts, two in series, will develop a tractive effort of 17,500 lb. and a speed of 21 m.p.h. One of these locomotives will handle a train of from 800 to 1000 tons gross weight. Each motor is geared to one of the axles, thus making all axles driving axles. A forged pinion is mounted on each armature shaft and meshes into a corresponding solid-steel gear mounted on the axle. The gear ratio is sixty-five to eighteen teeth, making 3.61 gear reduction. The continuous capacity of each motor is 200 amp under forced ventilation and 269 amp at the one-hour rating. For the complete equipment of four motors on a locomotive this is equivalent to a continuously sustained tractive effort of 11,200 lb. at the rail head.

The motor is inclosed and is designed especially for locomotive service. Through the method of forced ventilation employed air is circulated over the armature and field coils, over and through the commutator, through longitudinal holes in the armature core and thence exhausted through openings in the bearing head. A large volume of cool air is thus distributed effectively throughout the motor.

The rheostats are formed of cast-iron grids assembled in frames and insulated with mica. At each end of the rheostat compartment and suspended from the roof of the cab in laterally inclosed steel frames, accessible through lift doors at the sides, are grouped the contactors and the reverser. All mechanism and circuits carrying 1500 volts are thoroughly insulated and protected from accidental contact.

Sprague-General Electric multiple-unit control is employed. The pairs of motors with their respective resistances are all connected in series on the first point of the controller. The resistance is varied through six points and finally short-circuited on the seventh or running point. The pairs of motors are then operated similarly in series-parallel and all resistance is cut out on the twelfth point, which is the full-speed running point. This provides control connections with seven steps in series and five steps in series-parallel. The transition between series and series parallel is effected without opening the motor circuit, and there is no appreciable reduction in tractive effort during the change.

ELECTRIC LOCOMOTIVE

Energy is collected from the trolley wire by an overhead pantograph trolley, which is pneumatically controlled and can be put into service from either engineer's station by a manually operated valve. Some of the local lines are operated at 600 volts and in some cases as low as 500 volts, direct current. A change-over switch is provided for cutting out the dynamotor while the locomotive is operating on low-voltage circuits, so that in such cases energy for the auxiliary control and supply circuits is obtained directly from the trolley circuit. This change-over switch is protected by an automatic relay which makes it impossible to connect 1500-volt trolley energy to the auxiliary circuits of the locomotive.

The locomotives above described were designed and built by the General Electric Company, Schenectady, N. Y.

Automobile Radiator Heater

The Dubilier Electric Company, 63 Fifth Avenue, New York, has placed on the market a small automobile radiator heater, 6 in. by 7 in. by 0.5 in. in size, weighing 2 lb. The apparatus, shown herewith, com-

SMALL AUTOMOBILE RADIATOR HEATER

plete with plug and cord, is provided with a heating unit mounted between electrobestos strips protected by perforated-metal sheeting. The heater is designed particularly to maintain automobile radiators warm over night in the winter time and thus prevent the water in the radiators from freezing. The plug will fit any standard lamp socket.

Jobber, Dealer and Contractor

Electrical Credit Men of Indiana

Members of the Indiana division of the Electrical Credit Association of Chicago recently held a meeting at the Severin Hotel, Indianapolis, and discussed the book-credit systems now in use by the larger electrical companies. The credit standing of various firms was also touched upon. Mr. A. O. Kuehmsted, of Chicago, vice-president of the organization, was present at the meeting. The Electrical Credit Association has branches in various cities, from Cleveland to Denver and from Detroit to Dallas. Much interest in the prospects for the new Indiana organization was evinced by electrical men from all parts of the State.

The Stuff of Which Some Contractors Are Made

An electrical contracting and supply house in Brigham City, Utah, commenting on the caliber of some of the electrical contractors in that territory, writes that some of the boys once engaged by it as helpers are wiring houses away below standard with cheap material. Being in possession of a typewriter and printed letterheads, they are able to purchase 1907 code material from some Eastern supply dealers and thus easily beat the prices of reputable contractors, since there is no inspector in Brigham City and the municipality owns the lighting plant. Besides this, the boys do farmwork and haul coal between times. As there is no inspection of electrical work, the city electrician being elected by one of the political parties, a great many farmers and mechanics also do their own wiring work. The electrical trade, therefore, is progressing slowly in Brigham City and an electrician does not command a very high wage.

Conference on National Electrical Code

The regular meeting of the Electrical Conference was held in the rooms of the meter department of the Philadelphia (Pa.) Electric Company on Feb. 26. Mr. Washington Devereux, of the Philadelphia Fire Underwriters' Association, presided and explained in detail various sections of the National Electrical Code. The meeting was well attended, there being about 250 present, made up of electrical contractors, jobbers and central-station men. Mr. Louis J. Grossman, chairman of the committee on organization, submitted his report, and Mr. M. E. Arnold made a short address on co-operation. Mr. W. K. Kerford, vice-chairman of the conference, spoke of the willingness of the Philadelphia Electric Company to assist the electrical contractor in every way, especially at the time of starting two-phase motors and similar devices. The greater part of the evening was given over to discussions on the rules relative to switchboards and on motor control. These monthly meetings, which have as their object the education of the mechanic or practical man making electrical installations in the best methods and practices, have met with clearly marked success. The inspectors of the Philadelphia Fire Underwriters' Association, the Philadelphia Electric Company's inspectors and municipal inspectors also attended. The discussion is most informal, and any one, no matter what kind of situation he may hold, is free to rise and ask for information. The following officers will serve during the ensuing year. Chairman, Mr. Washington Devereux; vice-chairman, Mr. William Kerford; treasurer, Mr. Herman Eckstein, and secretary, Mr. Richard H. Silbert.

Humor and Pathos of Electrical Contracting

At the recent convention of the Tennessee Electrical Contractors' Association in Memphis Mr. J. A. Fowler, of the Fowler Electric Company of Memphis, dwelt on the pathetic and the humorous sides of the electrical contracting business. He told of a general contractor who had occasion to let a contract for electrical work costing $8,000. The general contractor used an estimate of $10,000 from a local electrical contractor, and after the former had secured the job he proceeded to peddle the electrical work instead of letting it to the electrical contractor whose bid he had used. Working two electrical contractors against each other, he finally secured one who undertook the work for $7,400, or $600 below cost.

The habit of doing work below cost is one of the most pathetic conditions in the electrical contracting business. Its origin is due to the fact that the contractor either does not possess the experience needed to estimate his costs properly or fools himself by not keeping a record of work while it is in progress and thereby has no means for gaging future costs. Unfortunately, this type of contractor who keeps no records is always confident that he is making money. In time, however, he is ruined and injures the creditors. The customer, however, profits, so that there is an element of humor along with an element of pathos. Some contractors make a practice of taking work below cost, expecting to obtain all future business of the customer or with an eye to the extras which may arise on the job. The contractor who pursues these methods is, according to Mr. Fowler, a dangerous element in the business, because in his efforts to protect his losses he violates the terms of his contract and cheats his customer by installing inferior work, besides exposing him and others to the attending dangers. If he does not resort to the foregoing method, he plans to rob his customer or his tenants on the extras he expects to get. One value of an organization such as the National Electrical Contractors' Association, it was pointed out, was shown in the efforts made to rid the business of this very undesirable type of contractor.

A curious intermingling of humor and pathos is found when a building is declared dangerous because of defective electrical work and the owner contracts to have the defects corrected by a contractor who does not know how or one who is dishonest and tries every means to have his work pass inspection, with the result in either case that the remodeled work is as bad as, if not worse than, that condemned, and the customer has spent his money for naught. It is a pathetic travesty on the claims for "safety first" when no effort is made to eliminate dangerous wiring conditions in hotels, rooming houses and workshops where the existence of these conditions is almost as dangerous as the presence of a store of dynamite. The dynamite in any case would be well guarded, but who can guard defective electrical work? The latter may cause trouble in a thousand places and at any time. Mr. Fowler said that the contractor should not let the taunt of self-interest deter him from making public a knowledge of defects. The practice of playing hide-and-seek with the electrical inspector and the owner is fast passing, owing to the co-operative efforts of honest electrical contractors, and while time was when the electrical inspector was forever warring such a condition is now exceptional. As a rule, the contractor meets the inspector more than half way in their mutual effort to turn out work that will stand the test of time and be a monument to the honesty and integrity of the contractor.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Factory of Altorfer Brothers Burned.—Altorfer Brothers Company, which has been manufacturing the "Alco" electric washing machine, and other washing machines, at Roanoke, Ill., has had the misfortune to suffer the complete loss of its factory by fire. Nothing daunted, however, the company has arranged for a temporary factory at Morton, Ill., and is now operating at that point.

Arkansas Hydroelectric Development Projected.—The Arkansas Hydroelectric Company has been incorporated to finance the development of a 10,000-hp water-power site on the Little River, near Heber, Ark. Three dams are to be built and about 100 miles of high-tension transmission line erected. Four 2500-hp generating units are to be installed in the plant, and the estimated cost of the work is $2,000,000.

Babcock & Wilcox Boiler Sales Satisfactory.—Among the larger recent purchasers of Babcock & Wilcox boilers and superheaters are the Bethlehem Steel Company, of South Bethlehem, Pa., which took 6702 hp, with superheaters; the Singer Manufacturing Company, of South Bend, Ind., which took 3120 hp, with superheaters; the Richmond Light & Railway Company, Staten Island, N. Y., which took 2416 hp, with superheaters, and the Middle West Utilities Company, of Kincaid, Ill., taking 1016 hp, with superheaters and chain grates. Other recent purchasers of this company's product in large quantities are the Crucible Steel Company of America, Pittsburgh, Pa., with 1206 hp; C. A. Smith Lumber & Manufacturing Company, of Marshalfield, Ore., with 1206 hp, and the Western Ohio Railroad Company, of St. Mary's Ohio, with 1304 hp, installed.

St. Louis League of Electrical Interests Going After South American Trade.—In an endeavor to increase its export trade in South America the Business Men's League of St. Louis has organized a foreign-trade excursion. The party will leave on April 1 for a visit to Bahia, Rio de Janeiro, San Paulo and Santos in Brazil, Montevideo in Uruguay, Buenos Aires in Argentina, Santiago and Valparaiso in Chile, Lima in Peru and other cities. In this expedition the St. Louis League of Electrical Interests, Jovian Chapter, will be represented by Charles E. Sharp. Mr. Sharp, who is addressed at the Security Building, St. Louis, has been identified with the export trade to Mexico for several years and has had considerable experience with the electrical requirements of that country. He is familiar with the customs of Latin-American people. The business men of St. Louis feel that, with the comparatively recent completion of the Transandine Railroad between Argentina and Chile, and the opening of the Panama Canal which is in prospect, they should be getting in closer touch with the business men in the centers of commerce in South America, so that they may secure a fair share of trade of South American countries.

Battery Manufacturer Planning New Equipment.—The William Roche Electrical Company, of 487 to 489 Greenwich Street, New York, is planning to extend its production facilities by the installation of two metal-frame tamping machines for the manufacture of its dry batteries. It is also planning to establish agencies in some of the larger Eastern cities. William Roche, the president of the concern, has been in the battery manufacturing business for a number of years and his product was used in some of the early signaling work. The United Booking Offices of America, a theatrical booking agency at 1564 Broadway, New York, has a unique installation of this company's batteries, which has made a good record under heavy service. The set operates a time stamp for recording the receipt dates on correspondence and other similar matter entering the office. The stamp functions once every minute for eight or ten hours a day, and the battery set for this service has been in operation for over a year without any renewals. The Roche Company was incorporated some months ago, with William Roche as president, A. I. Hoe as treasurer, and E. L. Ostendorf as secretary and general manager.

General Industrial Bearing of Pending Legislation.—At a dinner of the Westinghouse companies at Pittsburgh, Pa., March 7, Guy E. Tripp, chairman of the board of directors of the Westinghouse Electric & Manufacturing Company, gave a talk on the tendencies of the present administration and their bearing on the industrial future of the country in general, and of the Westinghouse companies in particular. His remarks were prefaced with the assertion that he believes with President Wilson that "private monopoly is indefensible and intolerable," and that its prohibition "will bring new men, new energies, and a new spirit of initiative, new blood, into the management of our great business enterprises," "will immensely hearten the young men coming on and will greatly enrich the business activities of the country." Mr. Tripp then took up the five pending administrative measures, which are being drawn up for the purpose of regulating monopolistic tendencies, and told wherein he thought them defective. The Interstate Trade Commission bill he thinks too drastic in its present form, but he believes that it could be modified to include both the Sherman law definitions bill and the trade relations bill, while excluding the portion which he considers objectionable. Mr. Tripp thinks also that the interlocking directorates bill and the anti-holding company bill should be materially changed so as not seriously to interfere with present business methods. If legislation should be framed along these safe and conservative lines, he believes that its effect will not be detrimental to the Westinghouse Electric & Manufacturing Company, since that has always been competitive.

Figures on Tin for 1913.—Statistics on this metal for the year 1913 contain figures of interest to the electrical industry. The total production of the world during that year was 119,000 long tons, of which over 52 per cent was shipped from the Straits Settlements, and nearly 21 per cent from Bolivia. About 4.9 per cent was produced in the Welsh mines in Cornwall. The world's consumption of tin during 1913 was approximately 116,000 long tons, of which over 39 per cent was taken by the United States. For the last ten years the American consumption has generally been higher in the first half of the year than in the second, and in 1913 this was particularly true. The deliveries in this country during March last year came to 5900 tons, the highest figure for a single month within the decade. The lowest figures on American monthly tin deliveries for the past ten years were reached in December, 1907, when only 1200 tons were delivered. The average monthly tin delivery in the United States for the past ten years has been 3400 tons, and the average for the last year was 3660 tons. Average tin prices experienced considerable variation from month to month last year, the high figure of 50.45 being reached in January, and the month of December showing the low average price of 37.64. While the largest ratio between maximum and minimum figures of monthly consumption during 1913 was 2.1, and the largest ratio between maximum and minimum monthly average prices was only 1.3, the largest ratio between the maximum and the minimum products of monthly average consumption and monthly average price was nearly 2.4, indicating that the actual conditions in the tin market during that year were rather more unsettled than the figures on either prices or consumption would seem to show.

Status of Commercial Travelers in Paraguay and Uruguay.—In Paraguay foreign commercial representatives and firms are divided into classes, according to their importance and the volume of business transacted, and the taxes levied are graded from about $500 a year down. That figure represents the tax on the first-class concerns in the

prinicipal cities, and the taxes on less important companies and in smaller communities are considerably lower. In many cases the commercial traveler is not required to pay the tax. Samples may be imported, duty free, on deposit of the amount of this duty, which is refunded on the re-exportation of the samples from the port of entry within the period allowed. The Uruguayan government places a license tax on all lines of business, and this applies to the representatives of foreign business houses. In the department of Montevideo this tax amounts to about $200 per year, and it is $100 a year elsewhere in the country. Application for a license is made to the police authorities on a special blank, and the license is valid from the date of issue until Dec. 31. The records show that few travelers pay this tax, as they find it preferable to associate themselves with local licensed firms in most cases. The privilege of free importation of samples has been allowed for years, and the furnishing of satisfactory security for the re-exporting of the goods, within the allowed period, is required. Samples are not allowed this privilege until the traveler has presented his license or proof of his connection with a local licensed firm. Goods are admitted free under bond, temporarily, in order to allow time for securing the license or effecting business connections.

Statement of the Copper Producers' Association for February

Every item in the February report of the Copper Producers' Association showed a decrease from the corresponding figures for January. A very simliar condition was observed during June, 1913, at the time of a marked slump in copper prices of much the same character as the present slump. The decrease in all items seems to be a pretty certain result of general stagnation in the industry. The shortness of the month affects the figures to some extent, and the exports, at a rate of practically 3,000,000 lb. a day, reached record figures. General industry, particularly along the electrical lines, shows increasing activity, and the domestic consumption in March will probably show a fair increase. Foreign deliveries have been above normal for some weeks, and will probably show a decline during March. Production during the present month will probably not suffice to prevent a further reduction of stocks. The complete figures for February are:

	February, pounds		January, pounds	
Stocks on hand in the United States on first of month		87,296,685		91,438,867
Production		122,561,007		131,770,274
		209,857,692		223,209,141
Domestic deliveries	47,586,657		47,956,955	
Foreign deliveries	83,899,183		87,955,501	
		131,485,840		135,912,456
Stocks on hand at at end of month		78,371,852		87,296,685

NEW YORK METAL MARKET PRICES

	Mar. 3 Bid	Mar. 3 Asked	Mar. 10 Bid	Mar. 10 Asked
Copper:				
Standard spot*	13.50	14.25	13.37½	14.00
	Selling Prices		Selling Prices	
	£ s. d.		£ s. d.	
London, standard, spot*	64 2 6		63 18 9	
Prime Lake	14.62½	to 14.87½	....	....
Electrolytic	14.37½	to 14.50	14.25	to 14.35
Casting	14.25	to 14.35	14.10	to 14.20
Copper wire base	15.50	to 15.75	15.50	....
Lead		4.00		4.00
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet zinc, f.o.b. smelter		7.25		7.25
Spelter, spot	5.32½	to 5.35	5.35	....
Tin, spot	37.90	to 38.25	37.62½	to 37.87½
Aluminum:				
Prompt delivery	18.50	to 18.75	18.37½	to 18.62½
Future	18.50	to 18.75	18.37½	to 18.62½

*OLD METALS

Heavy copper and wire	13.75	13.62½
Brass, heavy	8.87½	8.62½
Brass, light	7.87½	7.62½
Lead, heavy	4.05	4.00
Zinc, scrap	4.25	4.25

*COPPER EXPORTS

Total tons to March 10 13,712

*From daily transactions on the New York Metal Exchange.

Corporate and Financial

Cities Service Company Status.—The earnings statement of the Cities Service Company, recently issued, covering the year ended Dec. 31, 1913, shows a gross income of $2,172,411 and net earnings of $2,087,063. After deduction of interest and dividends on preferred and common stock, a surplus of $588,797 was realized for the year, making a total accumulated surplus of $2,146,080. These figures cover ten months' operation of the company alone and two months subsequent to its absorption of the Consolidated Cities Light, Power & Traction Company and the Utilities Improvement Company.

Proposed Telephone Merger in Chicago.—The project of the sale of the telephone property of the Chicago Tunnel Company to the American Telephone & Telegraph Company, for the Chicago Telephone Company, is again before the committee on gas, oil and electric light of the Chicago City Council. The price agreed upon by the prospective buyer and seller is $6,300,000, but the consent of the city is needed under the terms of the franchise by which the Chicago Tunnel Company conducts its telephone business. At a meeting of the Council committee on March 5 a resolution was adopted, after a warm debate, setting forth "That it be the sense of this committee that the committee is opposed to a dual system of telephones, provided this action shall not bind the committee to anything relative to the facts and figures of the proposed sale."

Baltimore Utility Planning Stock Issue.—The Consolidated Gas, Electric Light & Power Company filed with the Maryland Public Service Commission on March 6 application for permission to issue $1,106,800 worth of consolidated mortgage debenture stock bearing interest at 5 per cent, with the privilege of conversion at the option of the holder into common stock on the basis of $25 debenture stock for $100 par value common stock. The debenture stock is to be issued under and secured by an indenture of a deed of trust to the Fidelity Trust Company, dated May 1, 1913. The company also applied for permission to issue, when and as needed, for the conversion of the debenture stock, $909,800 of common stock. The company has already issued $3,893,200 debenture stock, convertible into full-paid common stock at the option of the holder at any time prior to July 1, 1916, and the new issue will bring the total amount outstanding up to $5,000,000.

Activities of Virginia-Western Power Company.—W. G. Mathews, president of the Virginia-Western Power Company, gives information of some interest in a letter published by the Central Trust Company of Ilinois as a part of a bond circular. The Virginia-Western Power Company was organized less than a year ago, and took over the physical properties of four electric-service companies operating in the western part of Virginia. The company serves the cities of Clifton Forge and Buena Vista, and the towns of Covington, Lexington and Iron Gate. It has recently purchased electric-service properties in Ronceverte, Lewisburg and Alderson, W. Va., these cities being directly west of the territory already served. At Clifton Forge the company owns a modern steam-turbine plant of two units with total rating of 1725 kw. A 14-mile transmission line extends from Clifton Forge to Covington and Iron Gate. On the North River, near Buena Vista, the company operates two small hydroelectric plants having a rating of 675 kw. There is a small steam plant at Ronceverte with a transmission line of 6 miles to Lewisburg. Energy is furnished for the operation of the Lewisburg & Ronceverte electric railway. At Alderson the company purchases steam power from a milling company, but the transmission of electricity from Ronceverte, 9 miles distant, is contemplated. In Clifton Forge the company sells all of the electrical energy used in the shops of the Chesapeake & Ohio Railroad. Lexington, one of the towns served, is the seat of the Virginia Military Institute, which has a high reputation for the character of its engineering instruction and has furnished a number of electrical engineers well known in the industry. The company has outstanding $300,000 in common stock and $126,000 in 6 per cent preferred stock. It has issued first mortgage 6 per cent bonds of a par value of $325,000.

Annual Summaries of Stone & Webster Properties.—The combined reports of the public utility properties under the control of the Stone & Webster Management Association for the year ended Dec. 31, 1913, show a total capitalization of $186,515,400, of which $86,512,100 represents outstanding securities, $38,092,100 preferred stock outstanding, and the remainder outstanding common stock. Gross earnings total $26,688,521, net earnings of $11,104,764 being realized. Interest charges amounted to $4,432,104 for the year, and during the same period dividends of $4,184,476 were paid. The associated companies own and operate about 1299 miles of single-track electric railway, carrying for the year 341,255,000 passengers. Their total connected lighting load at the end of the year was about 120,700 kw, and their combined commercial motor load was approximately 179,800 hp.

Annual Report of the Mackay Companies.—The financial report of the Mackay Companies for the year ended Feb. 1 showed total assets of $92,469,709, of which $91,997,714 represented investments in other companies, and the rest cash. There was $50,000,000 outstanding in preferred stock and $41,380,400 in common stock, while the surplus came to $1,089,309. The concern is the holding or controlling company for the Postal Telegraph Company and the Commercial Cable Company, and its receipts for the year, including income from investments in these companies, amounted to $4,202,413. Disbursements included a 4 per cent dividend on the preferred and a 5 per cent dividend on the common stock, an operating expense of $30,587, and a balance of $102,805. Clarence H. Mackay, president of the company, in his report to the shareholders stated that it has the largest combined land and ocean telegraph system in the world, although there are larger separate systems of both kinds. He expressed gratification at the outcome of the recent government action concerning the mutual relations of the American Telephone & Telegraph Company and the Western Union Telegraph Company, deprecated the policy of government ownership of telephone and telegraph facilities, and stated that in spite of the commercial expansion of wireless service the extension of both land and water telegraph lines has been progressing. Mr. Mackay said that the concern has no debts and that its preferred stock has not been increased for the past seven years, nor its common stock for the past nine years.

Monarch Electric Company, of Kansas City, Goes Into Bankruptcy.—On Feb. 9 Joseph M. Jones was appointed receiver for the Monarch Electric Company, of Kansas City. The receiver was appointed on the petition of creditors. The Monarch Electric Company was a dealer in electrical and telephone supplies at 1113 Wyandotte Street, Kansas City, Mo. Its officers were: President, F. L. Funsten; treasurer, S. C. Forbes; secretary, R. V. Hughes. The receiver's statement shows liabilities amounting to $82,305.70 and assets $90,422.09. It appears that R. E. Funsten, reported to be the father of the president of the company, advanced the corporation $10,000 in cash, for which he holds $7,138.37 worth of merchandise delivered to him by the corporation. R. E. Funsten also appears as indorser on $14,000 owing to the bank, and to protect himself on this indorsement he holds bills receivable due the corporation to an approximate amount of $10,212.88, which amount is included in the assets as stated. The National Reserve Bank holds a demand note for $750, to which is attached as collateral an assigned contract on which there is a balance due of approximately $2,060.12. The latter sum is also included in bills receivable mentioned in the assets. The contract is practically completed. It appears further that the Commercial Credit & Investment Company has heretofore advanced $7,566.96 to the Monarch Electric Company and has taken as collateral security the assignment of certain accounts and bills receivable in the sum of $9,014.45, which sum is included in the figures representing accounts and bills receivable. In the assets one item of $21,009.92 is given. This represents, according to the receiver, the overdrafts of various and former officers of the corporation, as well as funds of the corporation heretofore disbursed on dividend account, and it is doubtful, in the judgment of the receiver, whether any considerable amount can be realized from this sum.

Business Notes

The Cooper Hewitt Electric Company has appointed E. H. Waddington as district manager for the five states adjacent to Missouri, with headquarters at 1403 Central National Bank Building, St. Louis, Mo.

The Allen Bradley Company, of Milwaukee, Wis., has moved its Chicago office, in charge of F. L. Gohl, to 307 Webster Building, 327 La Salle Street, Chicago, Ill. The change was made necessary by a decided increase in business.

F. E. Gilbert, sales agent for the Bristol Company and the Weston Electrical Instrument Company in the Philadelphia territory, has announced the removal of his office to 303, 304 Hale Building, 1326 Chestnut Street, Philadelphia, Pa.

The Day and Night Sign System, Inc., has moved its office and factory from 424 West Sixth Street to 212 West Eleventh Street, Los Angeles, Cal. J. H. La Pearl is general manager of this company and Alexander Ots is sales manager.

The Eastern Electric Lamp Company, of Hartford, Conn., has opened an office and stock room at 45 Clinton Street, Newark, N. J., under the direction of P. M. Dreyfuss, who will retain his position in charge of the New York office at 47 West Street. The new quarters have been taken because of increased business.

The Terry Steam Turbine Company, of Hartford, Conn., has concluded arrangements with the firm of Fraser & Chalmers, Ltd., 3 London Wall Buildings, London, England, for handling the Terry turbines in England and its colonies, with the exception of Canada. This arrangement does not include marine forced-draft sets, which are to be handled by Yarrow & Company, Ltd., of Scotstoun, Glasgow, Scotland, as heretofore.

The Corbett & De Coursey Company, of Pittsburgh, Pa., has secured the services of J. A. Wahlgren as sales manager. Mr. Wahlgren was formerly assistant sales manager for the Western Electric Company in Buffalo, N. Y. The first-mentioned company is representing the Flexlume Sign Company, of Buffalo, and other concerns in the territory which includes western Pennsylvania, western New York, West Virginia, Ohio, and Indiana, and is in a position to take on some other good lines.

The H. W. Johns-Manville Company, of New York, has moved both its Indianapolis (Ind.) and its Louisville (Ky.) branches in order to secure larger quarters. The new address of the former branch is 408, 410 North Capital Avenue, Indianapolis, Ind., and the latter branch has been moved to 659, 661 South Fourth Avenue, Louisville, Ky. Both branches will have ample storage capacity and showrooms and a service department for the convenience of the company's customers in automobile accessories.

The Central Foundry Company, of 90 West Street, New York City, has taken over the business of the E. P. Morris Iron Works, 136 Liberty Street, but the sales end of the latter concern's operation will continue to be handled under the same name and at the same address as hitherto. Both companies have been active in the manufacture of cast-iron products, and the latter has supplied to the trade an extensive line of ornamental poles, brackets, and standards for street-lighting and combination trolley service.

New Industrial Companies

The Coles Company, of Akron, Ohio, has been incorporated with a capital stock of $1,000 by E. E. Otis and C. F. Berry. The company purposes to manufacture electrical appliances.

The E. E. Electric Sign Company, of Chicago, Ill., has been incorporated with a capital stock of $10,000 to manufacture and deal in electric signs. The incorporators are C. P. Barnett, J. C. Morgan, J. C. and G. C. Eubank and C. B. Boles.

Rogers & Hilton, of Syracuse, N. Y., have been incorporated by F. S. Rogers, J. S. Hilton and T. H. Hilton, of Syracuse. The company is capitalized at $25,000 and purposes to do a general electrical and mechanical engineering and contracting business.

The Acme Register Company, of Portland, Maine, has filed articles of incorporation under the laws of the State of Maine with a capital stock of $500,000. The company purposes to manufacture and deal in electrical devices or machines for registering, signaling, etc. The officers are R. A. Worth, president, and E. C. Keith, treasurer, both of Portland.

The Battery Equipment & Engineering Company, of Chicago, Ill., has been granted a charter with a capital stock of $1,000 to manufacture and deal in batteries, supplies, machinery, etc. The incorporators are David H. Jackson, Wilson K. Kline and R. M. Carroll.

Trade Publications

Oil-Filtering Systems.—S. F. Bowser & Company, Inc., Fort Wayne, Ind., are sending out a four-page circular telling the story in words and pictures of how a Bowser oil filter will save money. This company manufactures filters with capacities of from 5 gal. to 7000 gal. or more per day, built upon the dry system of filtration. Illustrations are shown of installations of the Bowser oil-filtering system in many industries.

Lifting Magnets.—The Electric Controller & Manufacturing Company, of Cleveland, Ohio, has recently issued, as an addition to its bulletin catalog, a reprint of an article by H. F. Stratton in *The Foundry* and the *Iron Trade Review* on the "Application of Electric Power in the Foundry." The paper touches on various motor-operated foundry tools, but is largely devoted to a general discussion of the uses of lifting magnets in the foundry.

Door Safety Switches.—An eight-page pamphlet on door safety switches for use with electric elevators has just been published by the Cutler-Hammer Manufacturing Company, of Milwaukee. Accidents on all types of elevators are often the result of setting the elevator machine in motion before the doors are closed and locked and the passengers clear. With the ever-increasing number of elevator passengers the safety feature is of utmost importance.

Signal Systems.—The application of electricity in the operation of hospital signal systems is the subject of the latest publication of the Holtzer Cabot Electric Company, of Brookline, Mass. Among the different pieces of apparatus illustrated and described for this service are extension push buttons, elapsed time recorders, buzzers, signal lamps and auxiliary equipment. Several complete systems are shown and described with plan views of the methods of installation.

Automatic Cut-off Valves.—The latest bulletin issued by the Lagonda Manufacturing Company, of Springfield, Ohio, on automatic cut-off valves, is an excellent example of the present-day type of engineering catalog, which is looked upon by engineers and plant managers as a text of concise information. This book takes up the causes and effects of water hammer in boilers, the effect of cutting in boilers below or above the pressure of the steam header, the specifications of boiler insurance companies, and the methods of government tests.

Brackets and Pole-Line Hardware.—The Hubbard Reference Book for 1914, recently issued by Hubbard & Company, of Pittsburgh, Pa., is an interesting and exhaustive catalog on the pole-line hardware put out by that company, including also the Pierce brackets, pins, poles, anchors and other transmission-line supplies. The book contains numerous photographs of actual installations of the above apparatus and gives also complete information as to the dimensions and prices of the same. Two special features of the book are a tabulation of the transmission-line construction details for 131 different high-tension systems and elevations of a number of different standard polyphase pole-line constructions.

Personal Mention

Mr. Percy W. Winters has been appointed manager of the Harrison (Ark.) Electric Light & Ice Company.

Mr. O. C. Small has succeeded Mr. L. C. Davis as editor of the *Union Electric Bulletin* of the Union Electric Light & Power Company of St. Louis.

Mr. James Ray Thomas resigned March 1 as superintendent of the Crawfordsville (Ind.) Electric Light & Power Company, a municipal plant.

Mr. John Gordon has been appointed foreman electrical engineer of the car department of the Grand Trunk Pacific Railway at Transcona, Man.

Mr. William J. Norton, of Norton & Bird, consulting engineers, Chicago, has been appointed one of the statesmen-at-large for the Jovian Order.

Mr. S. B. Clark has been appointed superintendent of construction of the Northwestern Electric Company of Portland, vice Mr. F. J. Walsh, resigned.

Mr. Charles A. Edwards, of Huntington, Ind., assumed his duties as a member of the Indiana Public Service Commission March 1, taking the place of Mr. Frank E. Payne, of Jeffersonville.

Mr. Richard C. Smith has resigned as sales agent of the Safety Insulated Wire & Cable Company to represent the Bishop Gutta-Percha Company of New York as traveling sales representative.

Mr. C. A. Learned, manager of the Meriden (Conn.) Gas & Electric Light Company, was elected president of the New England Association of Gas Engineers at its recent convention at Boston.

Mr. R. E. Flower, formerly contract agent for the Mobile Electric Company, Mobile, Ala., has been appointed assistant commercial manager of the Louisville Gas & Electric Company, Louisville, Ky.

Mr. J. E. Noeggerath, consulting engineer, New York, has returned from a seven months' trip to Belgium, Germany and Switzerland, where he made a special study of oil engines and centrifugal pumps.

Mr. Frederick L. Thornton has resigned as assistant auditor of the Kansas City (Mo.) Electric Light Company to become a member of the staff of Arthur Young & Company, certified accountants of that city.

Mr. John Kilgour, for many years president of the Cincinnati & Suburban Bell Telephone Company, has retired from active connection with the affairs of the company. His son, Mr. Bayard L. Kilgour, has succeeded him.

Mr. R. S. Hale, superintendent of the research department of the Edison Electric Illuminating Company of Boston, has returned from his honeymoon tour abroad, during the course of which he visited England, France, Germany, Switzerland and Italy.

Mr. F. J. Walsh, superintendent of construction for the Northwestern Electric Company of Portland, Ore., was tendered a banquet at the Multnomah Hotel, Portland, on severing his connection with the company to become chief engineer of the port of Astoria, Ore.

Mr. R. Vance Pearson, who has been connected with the electric line and service department of the Utah Light & Railway Company for the past ten years in Salt Lake City and Ogden, Utah, has been appointed to represent the company in the commercial field at Ogden.

Mr. Britton I. Budd, president of the Metropolitan West Side Elevated Railway Company and the other elevated railway companies of Chicago, was elected president of the Illinois Electric Railways Association at the annual convention of the association in Springfield, Ill., on March 6.

Mr. J. H. Trimmingham, who was assistant to the chief engineer of the Electrical Commission of the city of Montreal, Que., has been appointed superintendent of power for the Sherbrooke Railway & Power Company, Sherbrooke, Que., succeeding Mr. J. B. Woodyatt, who is now engaged with the Southern Canada Power Company.

Mr. Eugene H. Beil has been appointed manager of the Youngstown (Ohio) Consolidated Gas & Electric Company. Mr. Beil was in the employ of the Youngstown Consolidated Gas & Electric Company for fifteen years and severed his connection with the company three years ago to accept the position of electrical engineer with the firm of Day & Zimmerman, of Philadelphia, which position he now relinquishes to return to the Youngstown company.

Mr. L. N. Whitney, until recently general manager for the Central Union Telephone Company in Indiana, with headquarters in Indianapolis, is now general commercial superintendent of the New England Telephone & Telegraph Company, with headquarters in Boston. Mr. Whitney is a graduate of the Massachusetts Institute of Technology, class of 1896, and he has been a Bell telephone man during all of his business life. He was popular in Indianapolis.

Mr. Bert H. Peck has been appointed city telephone supervisor of Chicago. Mr. Peck will have charge of the telephone complaint bureau of the city, established by the terms of the telephone rate ordinance, under the supervision of Mr. Ray Palmer, commissioner of gas and electricity. Mr. Peck is a graduate of the University of Wisconsin in electrical engineering (class of 1906) and is a member of the American Institute of Electrical Engineers. He was until recently connected with the Chicago office of D. C. & Wm. B. Jackson, engineers.

Mr. Francis Edward Gobey, superintendent of rolling stock of the Lancashire & Yorkshire Railway, Manchester, England, is visiting the United States in company with Messrs. David Halliwell and S. C. Povey, of the same company, to make a study of American high-tension electrified railway lines. Particular attention will be paid to third-rail practice in view of the further electrification of the Lancashire & Yorkshire Railway. The party arrived on the *Lusitania* March 6 and plans to remain in the United States about one month.

Mr. Emil Huber-Stockar, engineer in charge for the Swiss government of the electrification of the Gothard tunnel, is visiting this country for the purpose of studying the operation of heavy electric railway systems, especially the New York terminal installations of the New York Central, Pennsylvania and New Haven railroads. Mr. Huber was formerly technical and managing director of the Oerlikon Company, near Zurich, Switzerland, and is president of the Swiss National Committee of the International Electrotechnical Commission. He will deliver an address on heavy electric traction before the New York Railroad Club on March 20.

Mr. F. N. Jewett, sales manager of the Wagner Electric Manufacturing Company, St. Louis, Mo., has had to relinquish the duties and responsibilities of his position temporarily because of a recent nervous collapse. He will, however, retain his connection with the Wagner company in the capacity of assistant to the executive officers. For the present he will devote his energies primarily to the restoration of his health, and will undertake only such duties as the state of his health will permit. Mr. Jewett's many friends are gratified to learn that his condition is showing very satisfactory, though somewhat slow, improvement, with the assurance of complete recovery in time. Mr. Jewett is a graduate of Cornell University, class of 1893. After graduation he entered the experimental department of the Payne Engine Company, Elmira, N. Y., where he remained until 1895. In 1895 he entered the New York sales office of this same company. He remained there until 1896, when the company went out of business. From 1896 to 1899 Mr. Jewett was with Evans, Almirall & Company, of New York, as salesman, and from 1900 to 1906 he was Western manager of the company, with headquarters in Chicago. In 1906 Mr. Jewett resigned and accepted a position with the Wagner Electric Manufacturing Company as manager of the Chicago district. Three years later he was made sales manager. Mr. Jewett is a member of the American Society of Mechanical Engineers, a member of the Society of Heating and Ventilating Engineers and an associate of the American Institute of Electrical Engineers.

F. N. JEWETT

Mr. Lynn C. Davis, for a number of years connected with the Union Electric Light & Power Company, of St. Louis, and its predecessors, resigned recently to accept a position on the editorial staff of the St. Louis *Post-Dispatch*. Mr. Davis was publicity agent of the company and editor of the *Union Electric Bulletin*. For several years he has been doing daily newspaper work "on the side," and he recently decided to give all his time to this work. Mr. Davis is a fluent writer of both prose and verse. He conducts a department in the *Post-Dispatch*, known as "Sport Salad."

Prof. Allan B. Field, of the department of mechanical engineering of the Victoria University, Manchester, England, who has been on a short visit to this country, sailed for Liverpool on the S. S. *Lusitania* on March 10. He is well known in this country, having been for many years connected with the Bullock and Allis-Chalmers companies in charge of their alternating-current departments at Cincinnati and Milwaukee. During the last four years spent in America he was in charge of the steam-generator work of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

Obituary

Burt Crouch, assistant sales manager of the St. Louis office of the Western Electric Company, is believed to have lost his life in the disastrous fire which destroyed the Missouri Athletic Club, St. Louis, March 9, causing the death of more than thirty persons. Mr. Crouch lived at the club and has been missing since the early morning disaster. He was about thirty-four years of age and unmarried. Before joining the forces of the Western Electric Company Mr. Crouch was employed by the Union Electric Light & Power Company. He was popular among the electrical men of St. Louis.

Frederick J. Newman, president of the Chicago Electric Motor Car Company, died at his home in Chicago on March 8, aged thirty-six years, after a long illness. Mr. Newman was well known in electrical and automobile circles in Chicago. For a number of years he was connected with the Woods Motor Vehicle Company of Chicago, being chief engineer and second vice-president at the time of his retirement to organize the Chicago Electric Motor Car Company, which he did about two years ago. Mr. Newman was born in Milwaukee and was a graduate of the University of Wisconsin. He leaves a wife and two children.

John Gott, chief electrician of the Commercial Cable Company, died of pneumonia and pleurisy at Brighton, England, March 8, at the age of seventy-four years. Always eminent as a submarine-telegraph engineer, Mr. Gott attracted the widest attention within the last year by the successful operation of his invention by which Morse characters can be sent through ocean cables and received in the same way as ordinary signals on land lines. As described in the *Electrical World* of March 29, 1913, page 659, each impulse of each letter is of reverse polarity, so that each impulse has the effect of neutralizing the preceding one, thus making for the greatest definition. With the Gott system a single circuit has been effectively operated from San Francisco to London. Born in 1840, young Gott entered the service of the Electric International Telegraph Company at the age of twelve. In 1861 he was stationed at Naples with the Italian telegraph system, and in 1863 was transferred to Alexandria in Egypt, meanwhile assisting in laying cables in the Mediterranean Sea. In 1865 he was one of the crew of the *Great Eastern* during its attempts to lay a transatlantic cable. Besides the reverse-impulse method of cable transmission above mentioned, Mr. Gott devised an improved fault-finder for locating cable leaks, a quadruplex system for land lines and an improved method of working submarine cables.

Construction

New England

WEYBRIDGE, VT.—Thompson, Shaw & Co., owners of the local electric-light plant, contemplate installing a larger generator within the next 18 months, but have not yet decided upon the time of installation.

ASHBY, MASS.—At a town meeting held March 2 a committee, consisting of John A. Pipe, chairman, Curtis Huckins and William Foresman, was appointed to investigate the question of obtaining a 24-hour electric service and report at a meeting to be held March 30. W. O. Loveland is owner of the local electric-light plant.

CAMBRIDGE, MASS.—The Cambridge El. Lt. Co. expects to purchase some electrolytic lightning arresters. Welles E. Holmes is treasurer and general manager.

HOLYOKE, MASS.—Within the next three months the electric light commissioners expect to erect an addition to municipal power house. Contracts have already been placed for one 4000-kw Westinghouse turbine, one switchboard panel and condenser. A. W. Derby is superintendent.

SPRINGFIELD, MASS.—The Crocker-Wheeler Co., of Ampere, N. J., has submitted a proposal to the city property committee offering to install a generator and other equipment in the municipal heating plant to furnish electricity for lighting the municipal group, the Central High and High School of Commerce buildings at the rate of from 4 cents to 5 cents per kw-hr. At the end of five years the company agrees to turn the equipment over to the city without further cost.

Middle Atlantic

ARGYLE, N. Y.—The Board of Supervisors of Washington County has authorized the committee to advertise for bids for the installation of an electric-lighting system in the county almshouse in Argyle, the cost not to exceed $3,000.

BATH, N. Y.—At an election held March 3 the proposal to issue $50,000 in bonds for the construction of a municipal lighting plant was carried. J. W. Taggent is village clerk.

FULTON, N. Y.—The Board of Public Works is considering plans and specifications for the proposed street-lighting contract. The agreement calls for not less than 400 6.6-amp tungsten lamps for a period of ten years. The city is to have an option on the purchase of the lighting system, exclusive of power house, until Dec. 31, 1917, at the physical value of the lighting system at the time of purchase.

HANNAWA FALLS, N. Y.—The Hannawa Falls Wtr. Pwr. Co. will build a new dam at Hannawa Falls to replace the old dam, which was badly damaged on Feb. 28.

ONEIDA, N. Y.—We are advised that the distributing system to be installed by the Kenwood El. Lt. Co. in certain parts of Oneida and Vernon for the purpose of furnishing electricity to the two villages is practically completed. The company is waiting for permission to be granted by the Public Service Commission to operate the system. An item stating that the company had made application to the Public Service Commission for permission to construct and operate transmission lines in the above towns was published in the issue of Feb. 21. H. V. Noyes is proprietor of the Kenwood El. Lt. Co. and the Oneida Community, Ltd.

BELLEVUE, PA.—The City Council has awarded a contract to the Duquesne Lt. Co., of Pittsburgh, for the installation of 32 arc lamps, to be placed at once on the principal business blocks. Bids are now being asked for the installation of a police signal system.

HOMER CITY, PA.—The City Council has appointed a committee to make investigations relative to the installation of a municipal electric-light plant. S. C. Steele is chairman of the committee.

PHILADELPHIA, PA.—The Philadelphia El. Co. is negotiating with William H. Steigerwalt for a lease of the property at 1004 Chestnut Street, on which it proposes to erect an addition to its present power house at Tenth and Chestnut Streets. Plans for the proposed extension will be prepared by John T. Windrim, architect, Commonwealth Building, Philadelphia.

PITTSBURGH, PA.—Bids will be received at the United States Engineer Office, Pittsburgh, Pa., until April 1, for furnishing and delivering steel maneuver boat hulls, engines, steamboat and hand capstans, electric-light plants, derricks, kevels, spuds, etc., for dams Nos. 1, 7, 9 and 28 on the Ohio River. Further information may be obtained upon application to Lt.-Col. Francis R. Shunk.

BEACH HAVEN, N. J.—The Borough Council is reported to have granted the Holmes El. Lt. & Pwr. Co., of Baltimore, Md., an electric-light franchise in Beach Haven.

ELMER, N. J.—We are informed that the borough of Elmer does not contemplate the installation of an electric-lighting system, as reported in the issue of Jan. 24. Hiram Van Meter is borough clerk.

MERCHANTVILLE, N. J.—We are informed that no definite action has yet been taken by the Borough Council relative to the installation of a municipal electric-light plant. W. F. McAllister is clerk. Reported in the issue of Feb. 28 to have received estimate for an electric-lighting plant.

NEWARK, N. J.—Bids will be received by the public building committee of the Board of Chosen Freeholders of the County of Essex, County Court House, Newark, N. J., until March 18, for furnishing material and for construction of a tuberculosis hospital at Overbrook, in the town of Cedar Grove, in accordance with plans and specifications prepared by Herman Kreitler, John F. Capen and Joseph B. Allen, architects. Separate bids will be received as follows: (1) masonry, carpentry, plumbing and painting work; (2) heating and ventilation work; (3) electric-lighting and power work. Copies of plans and specifications may be obtained upon application at the office of John F. Capen, 207 Market Street, Newark, architect, upon deposit of $25. Walter A. Evans is director of committee on public buildings.

CUMBERLAND, MD.—The Edison El. Illg. Co., of Cumberland, expects to erect a power house during the coming year; as yet nothing definite has been decided upon. W. M. Roberts, Jr., is general manager.

WOODSBORO, MD.—The Council is considering the question of submitting to the voters the proposal to issue $10,000 in bonds for the installation of an electric-lighting system and water-works.

MORGANTOWN, W. VA.—Plans have been prepared by W. S. Barstow & Co., 50 Pine Street, New York, N. Y., for extensive improvements to the system of the West Virginia Lt. & Trac. Co., of Morgantown, including the erection of a brick, steel and reinforced concrete power house (100 ft. by 150 ft., one story high), the installation of water-tube boilers, turbo-generators, water heaters, pumps, high-pressure piping, transmission equipment, etc. The cost of the work is estimated at $200,000.

BASIC CITY, VA.—The managers of municipal electric-light plant are erecting distributing lines and extending the street-lighting system. R. K. Stoutamyer is superintendent of lights.

SCOTTSVILLE, VA.—The installation of an electric-light plant and water-works system in Scottsville is under consideration. A committee has been appointed to look into the matter.

WASHINGTON, D. C.—Bids will be received at the engineer depot, United States Army, Washington Barracks, D. C., until March 17 for furnishing armored duplex, rubber-insulated, lead-sheathed cable as follows: (1) 19,500 ft. 81 circ. mils; (2) 4500 ft. 26,300 circ. mils; (3) 3020 ft. 106,000 circ. mils; unarmored duplex, rubber-insulated, lead-sheathed cable; (4) 5200 ft. 81 circ. mils. For further information address Lt.-Col. Joseph E. Kuhn.

WASHINGTON, D. C.—Following the installation of the new lighting system on Pennsylvania Avenue between the Peace Monument and the Treasury Building, plans are being made for improvements of other business sections of the city. Arc lamps (of the same type as those in Pennsylvania Avenue) will be installed on every thoroughfare between Seventh and Fifteenth Streets and Pennsylvania Avenue and G Street. In other sections of the business district 100-watt incandescent lamps will be installed, similar to those on Massachusetts Avenue and Union Station Plaza. Plans for these improvements have been practically completed and work will begin as soon as they are approved by the District Commissioners. The cost of the installation is estimated at $50,000 and will be borne by the Potomac El. Pwr. Co.

WASHINGTON, D. C.—Bids will be received at the engineer depot, United States Army, Washington Barracks, D. C., until March 17 for furnishing water-tight electric fixtures and accessories, including 110 water-tight service boxes without outlet couplings, 24 water-tight service boxes without cut-out or fuses, 38 water-tight service boxes with cut-out and six 75-amp fuses, 41 water-tight boxes without cut-out or fuses, 815 type X outlet couplings, 160 type Y outlet couplings and junction boxes with covers and gaskets as follows: 76 two-way, 93 three-way and 28 four-way. Bids will also be received at the same time and place for furnishing the following cable hangers, complete, with screws and expansion bolts: 5570 type O, 485 type 4, 25 type 6 and 1000 type 8. For further information address Lt.-Col. Joseph E. Kuhn, U. S. A.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until March 31, for furnishing at the various navy yards and naval stations the following supplies: Brooklyn, N. Y., Schedule 6512—eight tube cleaners, 130 low-pressure composition unions, eight 8½-in.-dial engine-room clocks; Schedule 6511—25,000 lb. naval bar brass. Boston, Mass., Schedule 6512—42 crucibles for melting composition, miscellaneous composition pipe fittings, 372 low-pressure composition unions; Schedule 6511—2060 lb. sheet brass, 2320 lb. sheet copper. Philadelphia, Pa., Schedule 6501—200 storage batteries for gun firing, etc.; Schedule 6512—300 ft. ¾-in. flexible-copper hose. Annapolis, Md., Schedule 6507—two blinker and speed light controllers, miscellaneous telegraph, rudder indicators, etc., two blinker and truck lamps, miscellaneous contact makers, etc., two telephones (type A, B, C, P and CN); Schedule 6500—18 portable desk lamps. Brooklyn, N. Y., Schedule 6506—one fire-control system. Washington, D. C., Schedule 6495—one motor-driven radial drill. Bids will also be received until April 14 as follows: Schedule 6514—annual supply of cotton and rubber insulating tapes for all naval stations and navy yards. Applications for schedule should designate the schedule desired by number. T. J. Cowie is paymaster general, U. S. N.

North Central

ANN ARBOR, MICH.—The Ann Arbor Merchants' Credit Association and the Business Men's Club are considering the question of installing a new street-lighting system in Ann Arbor.

AU SABLE, MICH.—The Au Sable El. Co., a subsidiary of the Commonwealth Pwr., Ry. & Lt. Co., has issued a mortgage to secure $1,500,000 in bonds, the proceeds of which will be used for improvements and extensions to its system.

BLISSFIELD, MICH.—Within the next two months the electric-light committee expects to install a single-cylinder (16-in. by 20-in.) Ball engine; also to purchase within the next four months several transformers. R. H. Ellis is superintendent.

BRIGHTON, MICH.—The Brighton Lt. & Pwr. Co., recently incorporated with a capital stock of $16,000, will take over the property of the Brighton El. Lt. & Pwr. Co. The Eastern Michigan Edison Co., of Detroit, it is said, will erect a transmission line from South Lyon and eventually take over the Brighton plant. C. C. Conrad will continue as manager.

COPEMISH, MICH.—A proposal has been submitted to the City Council by Col. E. Zimmerman, of Marquette, owner of the Betsey River dam, to furnish electricity for lamps and motors in Copemish.

KENTON, MICH.—The local electric-light plant, owned by the Sparrow-Kroll Lumber Co., is reported to have been destroyed by fire recently. The town is at present without electrical service.

NEWBERRY, MICH.—Bids will be received by E. H. Campbell, secretary board of trustees of Newberry State Hospital, Newberry, until March 16, for the erection of power house. Charlton & Kuenzi, of Marquette, are architects.

DAYTON, OHIO.—Plans are being considered for the installation of an ornamental street-lighting system on Wayne Avenue between Fifth Street and Xenia Avenue.

FREMONT, OHIO.—The Lake Shore El. Ry. Co., of Cleveland, is reported to have decided to increase the output of its steam power plant in Fremont by 500 hp or 600 hp. The work will include the installation of three large boilers and the erection of a brick smokestack 225 ft. high.

MASON, OHIO.—The proposal to issue bonds (about $10,000) for the installation of a municipal electric-light plant will soon be submitted to the voters. M. A. Castoe & Co., of Cincinnati, are consulting engineers. R. W. Gutermuch is clerk. Reported in the issue of Feb. 28 to have engaged Seidl & Hausman, of Cleveland, to prepare plans for electric-lighting system.

OAK HARBOR, OHIO.—The Council has accepted the proposal of the Northwestern Ohio Ry. & Pwr. Co., of Port Clinton, to furnish electricity in the village of Oak Harbor for a period of 10 years. The village will purchase the local plant and dis-

tributing system of the George Mylander estate. Bonds have already been voted to establish a municipal lighting system.

OSBORN, OHIO.—The Dayton Pwr. & Lt. Co., of Dayton, it is reported, has submitted a proposal to the Village Council offering to take over the municipal electric-light plant and to furnish electricity for the local system from its plant in Dayton. Work will begin on the erection of the transmission line as soon as the contract is signed.

URBANA, OHIO.—The Urbana Lt. Co. is contemplating extending its transmission lines to Cable and Kennard in addition to the line now being erected to the Catawba gravel pit.

VAN WERT, OHIO.—We are informed that the city of Van Wert does not contemplate the installation of a new lighting system, as reported in the issue of Feb. 28. Only a few slight changes and improvements will be made to the present system. Pierce Carr is city auditor.

BOWLING GREEN, KY.—We are informed that a power plant will not be installed at the State Normal School in Bowling Green in the very near future. Reported in the issue of Feb. 28 that Howard & Merriam, of Columbus, Ohio, were preparing plans for the erection of a power house.

CARLISLE, KY.—Within the next three months the Carlisle El. Lt. & Pwr. Co. expects to erect about 4000 ft. of transmission line to the water-works pumping station. No. 8 weather-proof copper wire will be used. The company also expects to purchase 50 poles (25-ft. to 30-ft., with 7-in. top). Boon Ingles is manager.

EDMONDTON, KY.—The Edmondton Lt. & Pwr. Co., recently incorporated with a capital stock of $1,250, is contemplating the installation of a small electric-light plant. For further information address George Greenup.

LOUISVILLE, KY.—The Louisville Pillow Co. expects to purchase an electrically operated freight elevator. M. P. Kelly is president.

LOUISVILLE, KY.—Plans are being prepared by Joseph & Joseph, of Louisville, architects, for a new factory building for the Bouvier Specialty Co., 801 West Main Street, Louisville. Electric motors will be needed to operate pumps, bottling and washing machinery.

SMITH MILLS, KY.—The municipality of Smith Mills is contemplating the installation of a municipal electric-light plant. The city, it is understood, will purchase a generator and engine.

BOURBON, IND.—The Union Wtr., Lt. & Pwr. Co., of Bourbon, has recently installed 12 standards for five-lamp clusters, 20 200-cp and 15 100-cp tungsten series street lamps. Elmer Kessler is superintendent.

CLINTON, IND.—The Clinton El. Lt. & Pwr. Co. expects to purchase 500-kw, 2300-volt, three-phase, 60-cycle generating unit (directly connected), with condensing outfit. C. M. Poor is superintendent and purchasing agent.

COLUMBIA CITY, IND.—The City Council is considering the question of installing a heating system. F. T. Schultz is superintendent.

FORT BRANCH, IND.—The Fort Branch El. Lt. & Pwr. Co. has been reorganized under the name of the El. Lt. Co. of Fort Branch. The local power plant is being dismantled and will be converted into a substation. Electricity for operating the local system will be purchased from the Evansville Pub. Ser. Co., of Evansville. When improvements are completed a 24-hour service will be established in Fort Branch, single-phase for lighting and three-phase for heavy motors. Homer T. Genung.

FORT WAYNE, IND.—Bids will be received by the Board of Public Works, Fort Wayne, until March 24 for furnishing and erecting turbo-generator set, exciter, condenser and switchboard, for municipal electric-light plant. Plans and specifications may be obtained from the Board of Public Works upon deposit of $10, which will be refunded upon return of same. For details see proposal columns. The Indiana Engineering & Construction Co. is consulting engineer.

GAS CITY, IND.—Within the next five months the electric light commissioners expect to rebuild about 2 miles of overhead transmission lines and to purchase one carload of poles and quite a quantity of weatherproof wire; also within the next six months to purchase some irons, fans and probably some washing machines. A contract has just been placed with the Westinghouse El. & Mfg. Co. for switchboard instruments, including meters, wattmeters, transformers, etc. T. S. McKee is superintendent.

KNIGHTSTOWN, IND.—The electric-light commissioners expect to erect within the next two months 40 five-lamp standards, using 3000 ft. of Okonite steel cable. N. Hiatt is superintendent.

KNOX, IND.—Thomas A. Christ, owner of the local electric-light plant, is contemplating purchasing energy or enlarging his plant. If it is decided to purchase energy, the system will be changed to alternating current.

PERU, IND.—The city of Peru is contemplating the purchase of a new street-lighting system. Arthur Herren is manager of the electric-light and water-works plant.

WALKERTON, IND.—Contracts have just been placed by the town of Walkerton for one panel for switchboard, three 30-kva, 13,200-volt transformers and necessary lightning protection. Within the next few months a small stock of electrical appliances and supplies will be purchased for use in connection with day service which will go into effect on or before April 1. A. L. Freyer is superintendent.

JOLIET, ILL.—The equipment of the proposed electric plant of the Joliet Mfg. Co. will consist of a 14-in. by 14-in. single-valve Ames engine directly connected to a Crocker-Wheeler 100-kva, three-phase, 60-cycle, 240-volt generator and switchboard equipment manufactured by the States El. Co. W. J. Steckel is superintendent of the company.

METROPOLIS, ILL.—The city of Metropolis expects to erect a retaining wall around the power house as a protection from the floods of the Ohio River. P. M. Richards is superintendent.

NEWTON, ILL.—The city of Newton would like to purchase a good second-hand 150-hp tubular boiler for the municipal electric-light plant; it also expects to purchase within the next 30 days a supply of electrical supplies, including heating and cooking apparatus, vacuum cleaners, washing machines, wiring supplies, etc. John W. Matheny is city clerk.

AMERY, WIS.—The Amery River Milling Co., recently organized with a capital stock of $40,000, proposes to generate and sell electricity. The incorporators are E. J. Schneider, E. M. Fay and others.

ELLSWORTH, WIS.—The State Railroad Commission has granted the Chippewa Valley Ry., Lt. & Pwr. Co., of Eau Claire, permission to purchase the property of the Ellsworth Ht., Lt. & Pwr. Co.; also authority to issue $42,000 in stock and bonds to apply on purchase of same.

JUNEAU, WIS.—The citizens have voted to issue $9,000 in bonds, the proceeds to be used for the erection of an electric transmission line and the installation of a distribution system for lighting the city. Electricity for operating the system will be purchased from the company in Horicon.

READSTOWN, WIS.—The installation of an electric-light plant in Readstown is under consideration.

UNION GROVE, WIS.—Application has been made to the Council by William Hary for a franchise to install an electric-light plant in Union Grove.

WAUKESHA, WIS.—The Waukesha Gas & El. Co. has just completed the installation of a 1250-kva Westinghouse turbine with Le Blanc condenser and two Murphy automatic smokeless furnaces. C. Rodman Stull is manager.

BLUE EARTH, MINN.—The town of Blue Earth expects to install a heating system, covering about four blocks, for which bids will be called within the next 60 days. Don Fitch is superintendent of the electric-light plant and water-works system.

FOREST LAKE, MINN.—The installation of an electric-light plant in Forest Lake is under consideration. C. E. Stewart is reported interested in the project.

HIBBING, MINN.—The extension of the ornamental street-lighting system in Hibbing is under consideration. It is proposed to erect five-lamp clusters (the same as are now in use) the entire length of Second Avenue and on the cross streets between Second and Third Avenue. On streets running east from Third Avenue three-lamp clusters will be placed; three-lamp clusters will also be used on Fourth Avenue.

ISANTI, MINN.—Messrs. Allen & Lovic, of Pine City, it is reported, have submitted a proposal to the Council offering to extend the transmission line from Grandy to Isanti, to furnish electrical service here.

ROUND LAKE, MINN.—The installation of a municipal electric-light plant in Round Lake is reported to be under consideration. R. D. Hart is village recorder.

WACONIA, MINN.—A proposal has been submitted to the Commercial Club of Waconia by General Luce, of the Luce El. Co., offering to extend a transmission line from St. Bonifacius to Waconia.

WILMOT, MINN.—Plans of the water and light commission to replace the present electric equipment with more modern machinery and increase the output of the plant, it is reported, have been approved by the City Council. The cost of the improvements is estimated at about $14,000.

WINNEBAGO, MINN.—The Commercial Club is promoting a movement for the installation of ornamental street lamps in the business district of the city.

ATLANTIC, IA.—Within the next 30 days the electric-light commissioners expect to purchase from 100 to 200 meters T. E. Nichols is manager.

CEDAR FALLS, IA.—The municipal electric-light plant, now under construction, will be placed in operation in about six weeks. C. H. Streeter is superintendent.

GARNER, IA.—The Enterprise El. Lt., Ht. & Pwr. Co., of Garner, expects to purchase within the next six months electrical appliances, including washing machines, vacuum cleaners, heating and cooking apparatus and supplies. H. F. Kellogg is superintendent.

GLENWOOD, IA.—The Glenwood El. Lt. & Pwr. Co. has recently extended its system and is now furnishing electrical service in Carson, Silver City, Mineola, Henderson, Emerson and Hastings, as well as Glenwood. The company, it is reported, is contemplating installing a new boiler and generator.

GLIDDEN, IA.—The electric light commission has decided to erect a transmission line from the municipal electric-light plant to furnish electricity to farmers residing more than 6 miles from town.

MASON CITY, IA.—An election will be held on March 26 to vote on the proposition to issue bonds for the installation of a municipal electric-light plant. W. A. Judd is water commissioner.

RIVERTON, IA.—At the annual election to be held March 30 the proposal to grant a franchise for the installation of an electric-light plant will be submitted to the voters. A local company, headed by Joseph Samuels, of the Nishna Valley Bank, has been organized to install the system.

SAC CITY, IA.—Within the next two months the Sac City El. Co. expects to erect a new concrete or brick power house (54 ft. by 105 ft.); also to purchase one second-hand 100-kw, two-phase, 60-cycle alternator (belted), two new 72-in. by 18-ft. return tubular boilers (one 150-hp and one 250-hp), a 300-hp Corliss engine, one 400-hp open heater and high-pressure piping for above equipment; also equipment for 11 miles of 13,200-volt high-tension transmission line, including step-up and step-down transformers, switch gear, lightning arresters, etc. H. W. Deininger is manager and engineer.

ST. ANSGAR, IA.—The Lt. & Pwr. Co., of St. Ansgar, expects to build a concrete dam (about 280 ft. long and 9 ft. high) across the Big Cedar River within the next year. O. H. Koch is secretary and treasurer.

WALKER, IA.—Arrangements, it is reported, have been made for the installation of an electric-light system in Walker. Electricity for operating the system, it is said, will be transmitted from Center Point.

WAUCOMA, IA.—At an election held March 2 the proposal to issue $12,000 in bonds to purchase water rights, build dam and erect an electric-light plant was carried. Work will begin on the project as soon as possible. H. H. Belding is city clerk.

BERNIE, MO.—A movement, it is reported, is on foot to organize a company to install an electric-light plant in Bernie.

CALLAO, MO.—At a special election held Feb. 24 the proposal to install a municipal electric-light plant was carried.

LINN CREEK, MO.—It is reported that a company will be organized under the name of the Central Missouri Pwr. Co. to construct and operate a hydroelectric plant at Linn Creek to develop 3000 hp. The plans provide for construction of dam, power house, transmission line, etc., to cost about $250,000.

BRYANT, S. D.—Within the next two months the commissioners of the municipal electric-light plant expect to erect an addition to power house and to purchase a 50-hp or 60-hp engine. W. A. McNulty is Mayor.

GAYVILLE, S. D.—A petition will be presented to the City Council asking that a special election be held to vote on the proposal to issue bonds for the installation of a municipal electric-light plant.

WINFRED, S. D.—The Town Council is considering the installation of electric street

lamps. A transmission line will be erected from Howard to Winfred to furnish the service.

BETHANY, NEB.—Bonds to the amount of $4,500 have been voted for the installation of an electric distributing system in Bethany. Electricity for operating the system will be secured from Lincoln.

HOOPER, NEB.—A company, it is reported, is being formed for the purpose of furnishing electricity for lighting the town.

OMAHA, NEB.—R. B. Howell, manager of the metropolitan water district, has authorized the engineering department of the water district to prepare estimates of the cost of construction and operation of a municipal electric-light plant in connection with the municipal water-works system. It would be necessary to secure authority from the State Legislature to install such a plant.

SHICKLEY, NEB.—The Town Board has appointed a committee to secure estimates of cost of the installation of a municipal electric-light plant.

ALTON, KAN.—The Council has engaged Rollins & Westover, Midland Building, Kansas City, Mo., to prepare plans and estimates of the cost of the installation and maintenance of a municipal electric-light plant and water-works system.

HERINGTON, KAN.—The Herington Water and Light Department expects to erect within the next three months 3 miles of transmission line (no poles will be required); also to purchase two motor-driven triplex pumps and 2200-volt, three-phase, 60-cycle, remote-control, slip-ring motors. A 75-kva General Electric alternator and 125-hp compound engine have been purchased for the municipal plant. E. J. Walcott is superintendent.

HOLTON, KAN.—Bids will be received by the Mayor and Council of the city of Holton at the office of B. B. Norris, city clerk, until March 24, for the erection of a city hall and fire department, in accordance with plans and specifications prepared by Holland, Gamble & Holland, architects, Topeka, which are on file in the office of the city clerk, Holton, and the office of the architects, Topeka. Separate bids will be received for steam heating, plumbing and electric wiring.

LARNED, KAN.—An election will soon be called to vote on the proposal to issue bonds for the installation of a municipal electric-light plant and ice factory in Larned.

NATOMA, KAN.—Application has been made to the town of Natoma by T. C. Miller for a franchise to install an electric-light plant here.

OTTAWA, KAN.—Within the next three months the board of water and light commissioners expects to purchase a boiler and will probably install a turbo-generator set some time during 1915. W. O. Myers is superintendent of water and light plant.

ROBINSON, KAN.—C. I. Stocking, of Hiawatha, electrical engineer, has been engaged by the City Council to prepare plans and specifications for a municipal electric-light plant and water-works system in Robinson.

ST. JOHN, KAN.—The installation of a municipal electric-light plant and ice factory in St. John is reported to be under consideration.

SEVERANCE, KAN.—The City Council has engaged C. I. Stocking, of Hiawatha, electrical engineer, to prepare plans and specifications for a municipal electric-light plant.

SOUTH HAVEN, KAN.—Within the next six months the South Haven El. Lt. Co. expects to purchase one 50-hp oil engine for direct connection to generator. J. R. Britton is engineer.

Southern States

BENSON, N. C.—The Benson El. Lt. Co., recently incorporated with a capital stock of $10,000, is installing an electric-light plant to furnish electricity for commercial purposes. Alonzo Parrish is president.

HAZLEWOOD, N. C.—We are informed that the town of Hazlewood will not install an electric-generating plant in connection with its lighting system, but will secure electrical energy from the hydroelectric power plant below Waynesville, owned by B. J. Sloan & Son. John N. Schoolbread, of Waynesville, engineer, has charge of the work. Reported in the issue of Feb. 28 to be contemplating the installation of an electric plant. William H. Cole is chairman of finance committee.

MARSHVILLE, N. C.—The proposal to establish a municipal electric-light plant in Marshville will be submitted to the voters on March 31.

SCOTLAND NECK, N. C.—Improvements, to cost about $10,000, it is reported, are contemplated to the municipal electric-light plant. A. L. Purinton is secretary.

WILSON, N. C.—Bids will be received by the commissioners of the town of Wilson until March 31 for improvements to electric-power plant, consisting of building, foundations, radial brick chimney, reservoir, pipe lines, power piping, centrifugal pumps and cooling system. Proposals will be received at the same time for water-tube boilers, two 500-kw generating units (engine-driven or turbine-driven), condensers and switchboard, under specifications dated October, 1913, and sent out at that time by the Board of Public Works. Specifications and proposal forms will be mailed upon application to Gilbert C. White, Charlotte, N. C., or to T. A. Hinnant, town clerk, Wilson.

LATTA, S. C.—Bonds to the amount of $65,000 have been voted for the installation of electric-light, water-works and sewer systems, plans for which have been prepared by the J. B. McCrary Co., of Atlanta, Ga.

AUGUSTA, GA.—Within the next ten months the Augusta-Aiken Ry. & El. Corpn., of Augusta, expects to purchase 4000 kw in transformers, 300 irons and 200 cooking units, such as toasters, coffee percolators, etc. J. J. Borger is superintendent of electrical department.

MACON, GA.—The stockholders of the Central Georgia Pwr. Co. and the Central Georgia Transmission Co. have decided to install additional generators in the plant at the Butts County dam, increasing the output to 24,000 hp. The cost of the work is estimated at $100,000.

LEESBURG, FLA.—Within the next six months the Leesburg Ice Co. expects to build an addition to its power house (all work will be done by the company); also to purchase within the next eight months an engine and generator with a rating of about 100 kw (the size not yet decided upon). J. Y. Clark is president.

ST. PETERSBURG, FLA.—The St. Petersburg El. Lt. & Pwr. Co. expects to put in operation a new power station within the next 30 days. The company has installed three 335-hp Erie City vertical boilers with superheaters, two generating units, consisting of 1200-hp Lentz cross-compound condensing engines directly connected to 750-kw General Electric three-phase generator, one 35-kw motor generator set and one 15-kw turbine exciter set, one 500-kw Westinghouse rotary converter and one 200-kw General Electric motor-generator set.

TAMPA, FLA.—Within the next six months the Tampa El. Co. expects to purchase two 520-hp high-pressure, superheated boilers with stokers. J. C. Woodsome is manager.

COLUMBIA, TENN.—The City Council has granted John H. Carpenter, of Nashville, a franchise to construct and operate an electric-light, power and heating system in Columbia.

HALLS, TENN.—At an election held recently the proposal to issue $25,000 in bonds for purchasing the Hall Lt., Wtr. & Ice Co. was carried.

KNOXVILLE, TENN.—John W. Flenniken, commissioner of street and public improvements, in his annual report recommends the installation of a municipal electric-light plant and a garbage disposal plant.

BIRMINGHAM, ALA.—The Birmingham Ry., Lt. & Pwr. Co., it is reported, will build a substation to cost about $125,000, to distribute electricity generated at the hydroelectric power plant of the Alabama Pwr. Co. at Lock 12 on the Coosa River.

TUSKEGEE, ALA.—The trustees of the Tuskegee Normal and Industrial Institute have authorized the installation of an electrical system, water-distribution system, steam piping and sewer system. The cost of the work is estimated at about $240,000.

WAYNESBORO, MISS.—The Waynesboro Electrical Co., recently organized, is contemplating the installation of an electric plant to develop 60 hp, at a cost of about $6,000. C. C. Green is president.

GREEN FOREST, ARK.—The Green Forest El. Lt. & Pwr. Co., it is said, is planning to install an electric-light plant, to cost about $10,000. L. H. Smith is reported to be interested in the company.

HUNTINGTON, ARK.—The Huntington El. Lt. & Pwr. Co., it is reported, contemplates the installation of additional machinery in the fall. G. W. Skow is general manager.

MAGAZINE, ARK.—The Magazine El. Co., recently granted a franchise in Magazine, it is reported, will install an electric-light plant, bids for construction of which will be received soon. Electricity for operating the system will be secured from Booneville. A transmission line 7 miles long will be erected. J. L. Roberts is manager.

ABBEVILLE, LA.—Bids will be received by Adolph Brasseux, Mayor, until March 26 for furnishing and installing machinery for the municipal electric-light plant, according to specifications prepared by Harold Raymond, consulting engineer, New Orleans, La.

TEXHOMA, OKLA.—The plant of the Pleasanton Handle & Mfg. Co. has been purchased by F. M. Harn, who, it is said, will install an electric plant and ice factory. Mr. Harn, it is reported, would like to receive prices on a 100-kw, 60-cycle, 2300-volt generator.

BRENHAM, TEX.—The Brenham Wtr. Wks. Co., it is reported, is contemplating the installation of electrical equipment in its plant here. H. E. Booker is superintendent.

FLORESVILLE, TEX.—Extensions and improvements, including the installation of new machinery, are being made to the property of the Floresville Ice & Pwr. Co., which was recently purchased by J. B. McCluskey and H. E. Brown, of Brenham, and E. H. Shoults, of Houston. A street-lighting system for the city may be installed later on.

HAMILTON, TEX.—The Hamilton Lt. & Pwr. Co. has just completed reconstruction of its plant, changing the system from direct current to alternating current. A new 100-kw General Electric generator has been installed. All new transformers and meters are of the General Electric make. W. A. Haynes is manager.

ROCKDALE, TEX.—The city of Rockdale is reported to be negotiating for the property of the Rockdale Wtr. & Lt. Co.

SAN ANGELO, TEX.—The San Angelo St. Ry. Co., it is reported, is contemplating improvements to its system, including the erection of a new power house, installation of new machinery and the extension of transmission lines, at a cost of about $35,000.

SEADRIFT, TEX.—The installation of an electric-light plant in Seadrift is under consideration. Mr. Gill, of Texarkana, is reported interested in the project.

TEMPLE, TEX.—The City Council, it is reported, will soon ask for bids for the installation of an electrically operated pumping unit at the river station of the city water-works system, to cost about $4,000.

TEXAS CITY, TEX.—The installation of an ornamental street-lighting system on Sixth Street is under consideration. The plans provide for the erection of concrete posts (12 ft. high) carrying three-lamp clusters.

Pacific States

BELLINGHAM, WASH.—The contract for the equipment for the power plant of the Bloedel-Donoval Mills Co., of Bellingham, has been awarded to the Allis-Chalmers Mfg. Co., of Milwaukee, Wis. The equipment will consist of two 750-hp Stirling water-tube boilers, one 1000-kw, three-phase, 60-cycle, 480-volt turbo-generator, switchboard and barometric condenser; also 42 three-phase, 60-cycle, 440-volt motors to drive the various machines in the lumber mills. W. V. Sullivan, of San Francisco, Cal., is engineer in charge of construction.

EDMONDS, WASH.—Within the next six months the Edmonds El. Lt. & Pwr. Co. expects to erect 1 mile of 2300-volt transmission line to furnish electricity in the rural district north of Edmonds, with secondary branches: also to purchase 50 meters, several 3-kva and 5-kva transformers and wire, and within the next three months to purchase several electrical cooking stoves. A. A. Cobb is vice-president, secretary and superintendent.

RAYMOND, WASH.—The Willapa El. Co., of Raymond, expects to purchase material for some miles of distribution line in Raymond and South Bend. J. S. Thornton is president.

SPOKANE, WASH.—The city commissioners have granted the Trustee Co., a local corporation, a franchise to lay pipes, conduits and wires in certain streets of the city, in connection with a steam or hot-water-heating system and electric light and power system which the company proposes to build in Spokane, at a cost of $100,000. Harry A. Flood is president.

FLORENCE, ORE.—The Florence El. Co. expects within the next 24 months to develop a water-power and erect 10 miles of high-tension transmission line to connect the system with its steam plant in Flor-

ence; also to purchase waterwheel to develop 200 hp under a 300-ft. fall, with minimum of 20 second-ft. of water. The company handles electrical appliances and supplies. G. G. Bushman is president.

NEWPORT, ORE.—The property of the Yaquina El. Co., of Newport, is reported to have been purchased by A. Welch and C. E. Welch, of Portland, construction engineers, who, it is said, will make improvements and extensions at once. Welch Brothers, it is reported, are contemplating the construction of a generating station in Toledo to supply electricity in Toledo and Newport. Water rights were recently secured by the Welch Brothers on the Siletz River in Lincoln County, where, it is understood, they will erect a hydroelectric plant to develop 2500 hp, at a cost of about $150,000.

PORTLAND, ORE.—The contract for the electrical installation for the new Broadway Theater has been awarded to the West Coast Engineering Co., Couch Building, Portland. This company was also awarded the contract to overhaul the electric wiring system in the Portland Academy. The work will include the rewiring part of the premises, the installation of new lighting units and a general overhauling of the entire system of wiring.

COVINA, CAL.—The city of Covina is installing an ornamental street-lighting system to cost approximately $15,000. Forty-two posts have been erected, covering both sides of street (4000 ft.), at a cost of $5,000. Bids for the remainder of the work will be asked about April 15. Pressed-steel and copper-fluted posts, 11 ft. 6 in. high, carrying a 16-in. globe, are being erected. The plans provide for 132 standards, of which 42 will carry 100-watt tungsten lamps and the remainder 60-watt lamps. About 23,000 ft. of sherardized conduit (from ¾ in. to 2 in. in diameter) will be used. F. G. Dessery, Central Building, Los Angeles, is city engineer.

LOS ANGELES, CAL.—The power committee has asked the City Council to call an election at once to submit the proposal to issue $6,500,000 in bonds to the voters, the proceeds to be used to complete the aqueduct power project and to install or acquire a municipal distributing system for aqueduct power. E. F. Scattergood is chief electrical engineer.

LOS ANGELES, CAL.—The Consolidated Utilities Co., operating in Compton, and the Glendore Lt. & Pwr. Co., which furnishes electrical service in Glendora, have applied to the State Railroad Commission for permission to sell their properties to the Pacific Lt. & Pwr. Corpn., of Los Angeles. The consolidated company agrees to sell its plant for $8,500 and the Glendora company values its property at $10,500.

SAN DIEGO, CAL.—The San Diego Gas & El. Co. expects to purchase one 5000-kva Curtis General Electric horizontal turbo-generator, two 600-hp Babcock & Wilcox horizontal water-tube boilers, one 100-kw Curtis General Electric horizontal turbo-exciter unit, three 100-kva, 2300/11,000 transformers. H. H. Jones is manager.

SAN FRANCISCO, CAL.—Bids will be received by Lt.-Col. George McK. Williamson, office of constructing quartermaster, Fort Mason, Cal., until March 25 for constructing ward at Letterman Hospital, San Francisco, including plumbing, heating and electric wiring. Plans and specifications may be obtained upon application to the above office upon deposit of $10, which will be refunded upon return of same.

CAMBRIDGE, IDAHO.—The Rush Creek falls, situated near Cambridge, will be utilized by the Adams County Lt. & Pwr. Co. to generate electricity, which will be transmitted to Cambridge, thence to Midvale and Council. The plant will be situated 12 miles north of Cambridge. The plans provide for the construction of a 16-in. pipe line 1200 ft. long, which, during low water periods, will generate between 450 hp and 500 hp.

HOMEDALE, IDAHO.—The Homedale Lt. & Pwr. Co. has applied to the Public Service Commission for permission to construct and operate an electric light and power plant in Homedale.

LAPWAI, IDAHO.—The Village Board has granted the Lewiston-Clarkston Imp. Co., of Lewiston, a franchise to erect transmission lines in Lapwai. The franchise is for a period of 25 years and provides that the system must be in operation by July 15, 1914.

GLOBE, ARIZ.—The installation of a municipal electric-light plant in Globe is under consideration. H. C. Houser is city clerk.

GLENDIVE, MONT.—The Glendive Ht., Lt. & Pwr. Co., it is reported, contemplates the construction of a hydroelectric power plant on the Yellowstone River, near here, to cost about $75,000.

LEWISTON, MONT.—The installation of an ornamental street-lighting system in the business district is under consideration. The plans provide for the erection of five-lamp clusters to cost $125 per standard.

EVANSTON, WYO.—The Evanston El. Lt. Co. expects to complete changing its system from direct current to alternating current, which it started last year, within the next six months. Within the next 90 days the company expects to purchase one 250-kw generator and Corliss engine (belted unit), and one 150-hp horizontal tubular boiler, two generator switchboard panels, one feeder panel and one voltage regulator. H. L. Williams is manager and purchasing agent.

ALAMOSA, COL.—The Mutual El. Lt. & Pwr. Co. expects to purchase within the next six months two carloads of poles, one graphic recording meter and one tub transformer. H. A. Goodridge is manager.

GYPSUM, COL.—Within the next six months the Schumm Lt. & Pwr. Co., of Gypsum, expects to erect a power house and to purchase a 75-kw generator and waterwheel, waterwheel governor, switches, transformers, poles, wire, etc., for an auxiliary plant. Casper Schumm is president.

Canada

CALGARY, ALTA.—The city commissioners recommend that a by-law appropriating $300,000 for the purchase of new equipment for equipping the transforming and switching station at Victoria Park and for the underground cables for the municipal lighting system be submitted to the ratepayers.

EDMONTON, ALTA.—Within the next three weeks the city commissioners expect to purchase one 6000-kw turbo-alternator with surface condenser and auxiliaries; also boiler plant with a capacity of 120,000 lb. per hour. The city also expects to erect a new power house within the next 18 months. R. H. Parsons is superintendent of city power plant.

LETHBRIDGE, ALTA.—Within the next nine months the managers of the municipal electric-light plant expect to erect 2½ miles of 00-feeder line to replace old feeder line; also to purchase within the next six months switches and instruments for extensions of switchboard. Arthur Reid is commissioner of public utilities.

VERNON, B. C.—A by-law will probably be submitted to the ratepayers in the near future asking for an appropriation of $11,500 for extensions to the municipal electric-light system.

DAUPHIN, MAN.—Within the next three months the town of Dauphin expects to install one 100-hp return tubular boiler, one jet condenser, one vertical, two-cylinder condenser, one 225-kw Canadian General Electric generator, exciter and switchboard with accessories, all Canadian General Electric equipment. W. A. Brinkman is superintendent.

SHOAL LAKE, MAN.—The Village Council has engaged the John Galt Engineering Co. to prepare plans and to act as consulting engineer in connection with the construction of the proposed municipal electric-light plant, which will be installed as soon as debentures are sold. F. Dobbs is secretary and treasurer.

CREEMORE, ONT.—The Village Council has entered into an agreement with the Hydro-Electric Commission of Ontario for 75 hp. The commission will install the system. A. H. Watson is village clerk.

PRESTON, ONT.—The City Council is contemplating extensions and improvements to the municipal electric-light plant.

TORONTO, ONT.—Bids will be received by H. C. Hocken, Mayor, chairman of Board of Control, Toronto, until March 17 for construction of police station on Davenport Road, including plumbing, heating, electric wiring and lighting fixtures. Plans and specifications may be seen and form of tender obtained at the office of the city architect, city hall, Toronto.

PRINCE ALBERT, SASK.—The City Council is considering the installation of an additional 750-kw turbo-generator unit in the municipal steam power plant. H. E. Pawson is manager.

REGINA, SASK.—Bids will be received by the city commissioners of Regina, Sask., until March 28 for generating equipment as follows: (1) For station switchboard, consisting of two exciter panels, six generator panels, one totaling panel and 16 feeder panels; (2) six three-phase feeder regulators; (3) one 125-kw motor-driven exciter; (4) one 125-kw geared turbine-driven exciter, electrical end speed not over 900 r.p.m. Distributing equipment: (1) Weatherproof copper wire; (2) insulators, top pins, etc.; (3) cross-arms; (4) pole-line hardware; (5) cedar poles; (6) pole-type transformers; (7) street-lighting equipment; (8) cut-out mast-arms; (9) integrating wattmeters. Copy of specifications may be obtained from E. W. Bull, superintendent of light and power, Regina.

SUTHERLAND, SASK.—The Town Council has appointed a special committee to look into the question of installing an electric plant in Sutherland.

Mexico

CITY OF MEXICO.—The federal government has given a concession to Jacinto Barrera and Salvador Luque for the use of the waters of the Tonantongo River, State of Hidalgo, for hydroelectric purposes.

Miscellaneous

CORDOVA, ALASKA.—Application has been made to the City Council by H. H. Knox, of Cordova, for a franchise to construct and operate an electric-light plant here.

PANAMA.—Bids will be received at the office of general purchasing officer, Isthmian Canal Commission, Washington, D. C., until March 25 for furnishing sheet copper, curb boxes, valves, ball cocks, steam gages, street lamps, calcium carbide, etc. Blanks and general information pertaining to this circular (No. 833) may be obtained at the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco. Major F. C. Boggs is general purchasing officer.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until March 28 for furnishing light fixtures and supplies for batteries on the fortification on the isthmus. The specifications include lamp fixtures, switch boxes, boxes for plugging-in devices, junction boxes, couplings, plugs and nipples, globes, guards, snap switches, coupling gaskets, receptacles, switch panel boxes, outlet couplings, plug fixtures, feeder and service boxes, cable hangers, wood screws and expansion bolts, and lead-sheathed armored and unarmored cable. For further information address Major F. C. Boggs, general purchasing officer.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until March 28, for lighting fixtures, switch panel and feeder boxes, cable hangers and armored cable for wiring within the batteries, Panama Canal fortifications; also steel plates and soft-steel bars. Blank forms and general information relating to this circular (No. 834) may be obtained at the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

New Incorporations

LOS ANGELES, CAL.—The International El. Ltg. Co. has been incorporated with a capital stock of $500,000. The directors are B. T. Wilson, D. W. Shoemaker, T. L. Croom, H. W. Janicke and Mary W. Croom.

PORTLAND, MAINE.—The Central States Ry. & Lt. Co. has filed articles of incorporation under the laws of the State of Maine with a capital stock of $500,000. The company proposes to acquire and operate water power, generate and sell electricity, etc. M. M. Reid, of Ironwood, Mich., is president, and J. E. Chase, of Portland, Maine, is treasurer.

BROWERVILLE, MINN.—The Browerville El. Lt. & Pwr. Co. has been incorporated with a capital stock of $10,000 by H. E. Hart, Thomas Heid, C. O. Scow, Henry W. Schroeder, George A. Monnie, Carl Zuhl and Lambert Irsfeld.

WAYNESBORO, MISS.—The El. Lt. Co. has been organized by J. A. Leggett, O. R.

Green and C. C. Green, with a capital stock of $30,000.

McINTOSH, S. D.—The McIntosh El. Co. has been incorporated with a capital stock of $5,000 by E. W. Luke, Harry Luke and W. D. Snyder. The company proposes to install an electric-light plant in McIntosh.

DAYTON, TENN.—The Dayton Lt. & Pwr. Co. has been incorporated with a capital stock of $100,000 by J. L. Faust, M. N. Whitaker, S. E. Whitaker, R. F. McClure and C. O. Lindsay.

QUANAH, TEX.—The Quanah Lt. & Pwr. Co. has been incorporated with a capital stock of $5,000 by J. C. Keys, E. W. McClintic and A. A. Keys.

ELKTON, VA.—The Valley Pwr. Co. has been incorporated with a capital stock of from $40,000 to $100,000. The officers are: Charles McCoy, president, and A. D. Hoyt, secretary, both of New York, N. Y.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 3, 1914.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York, N. Y.]

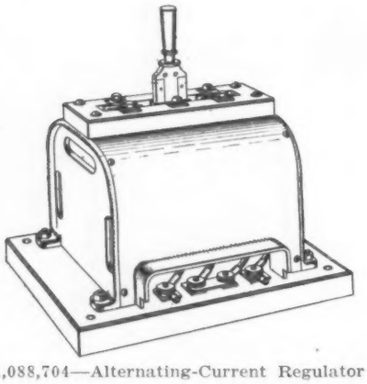
1,088,686. TRANSMITTER FOR WIRELESS TELEPHONY; W. T. Ditcham, Twickenham, England. App. filed April 9, 1913. Has high-frequency quenched-spark circuit connected to direct-current circuit between inductances.

1,088,704. ALTERNATING-CURRENT REGULATOR; S. E. Johnannesen, Pittsfield, Mass. App. filed Sept. 16, 1909. Reactance coils and transformer are combined into one structure.

1,088,707. TROLLEY-WIRE CONNECTOR; J. Kirby, Douglas, Ariz. App. filed May 31, 1912. Arranged so that trolley wheel can take current from the wire while passing over the connector.

1,088,734. CARBON ELECTRODE HAVING PROTECTIVE COVERING AND PROCESS FOR PRODUCING SAME; C. H. Schroers, Duisburg-Meiderich, Germany. App. filed March 14, 1913. A layer of closely arranged particles of granular material unaffected by oxidizing gases is embedded in the surface of the electrode.

1,088,736. MAGNETO; L. J. and L. E. Sevison, Elkhart, Ind. App. filed July 31, 1913. Special circuit-breaker spring and adjustable supporting yoke; also special lubricating system.



1,088,704—Alternating-Current Regulator

1,088,740. METHOD OF PRODUCING LIGHT; C. P. Steinmetz, Schenectady, N. Y. App. filed March 5, 1900. Modifies colors of mercury-vapor arc lamps by addition of color-modifying vapors of a metallic salt.

1,088,769. SWITCH; H. W. Cheney, Milwaukee, Wis. App. filed Feb. 4, 1910. Double-throw oil switch.

1,088,771. ELECTROMAGNETIC DEVICE; W. W. Dean, Chicago, Ill. App. filed June 5, 1903. Bell of the "tuned reed" type.

1,088,780. ELECTROMEDICAL EXERCISING APPARATUS; J. Katz, Chicago, Ill. App. filed July 5, 1913. Dumbbell containing battery, induction coil and hand contacts.

1,088,781. ELECTRIC GENERATOR; J. F. Kelly, Pittsfield, Mass. App. filed Dec. 20, 1910. Multi-circuit compound-wound machine.

1,088,814. RAILWAY VEHICLE MAGNET AND ROADWAY THEREFOR; A. H. Fox, New York, N. Y. App. filed March 25, 1908. Magnet on train co-operates with magnetically interrupted running rail or other armature on the roadway.

1,088,821. TROLLEY HEAD; O. N. Iverson, Hills, Minn. App. filed Feb. 28, 1913. Suspended weight throws guards at opposite sides of trolley wheel into operation as car sways.

1,088,866. LAMP-SUPPORTING DEVICE; R. B. Benjamin, Chicago, Ill. App. filed April 7, 1911. Socket for series connection in high-tension circuits.

1,088,867. ELECTRIC-LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed July 18, 1910. High-tension series socket in which lamp contacts are short-circuited in case of destruction of the lamp.

1,088,868. LAMP-SUPPORTING DEVICE; R. B. Benjamin, Chicago, Ill. App. filed April 22, 1911. High-tension series socket whose parts are locked together by a plug having contacts separated and normally held apart by a dielectric.

1,088,878. ELECTROMAGNETIC DEVICE; H. P. Clausen, Rochester, N. Y. App. filed March 25, 1907. Telephone relay.

1,088,879. TELEPHONE SYSTEM; H. P. Clausen, Rochester, N. Y. App. filed Sept. 6, 1911. Central-energy multiple type.

1,088,884. PNEUMATO-ELECTRIC TRACKER BAR FOR MUSICAL INSTRUMENTS; C. W. Dorricott, Philadelphia, Pa. App. filed June 21, 1912. For either sixty-five or eighty-eight note music and adapted to be associated with known forms of roll holders.

1,088,887. ELECTRICAL HEATER; G. A. and L. Edmison, Los Angeles, Cal. App. filed May 26, 1913. Has hollow vertical iron tube with resistance wire wound thereon.

1,088,893. AUTOMOBILE HORN; H. H. Frey, Chicago, Ill. App. filed June 29, 1912. May be operated by direct current or by alternating current from the usual ignition system.

1,088,897. ELECTRICAL MEASURING INSTRUMENT; K. Gyr, Zug, Switzerland. App. filed March 27, 1911. Transmits indications from the dial (pivoted on a vertical axis) by optical means onto a screen from which the readings are taken.

1,088,901. ARRANGEMENT FOR PROTECTING ELECTRIC CIRCUITS AND APPARATUS; P. V. Hunter, Newcastle-upon-Tyne, England. App. filed July 31, 1911. Current conditions in the faulty feeder alone control circuit-breaker to cut it out.

1,088,902. CABLE FOR ELECTRIC-CURRENT DISTRIBUTING SYSTEM; P. V. Hunter, Newcastle-upon-Tyne, England. App. filed Feb. 14, 1912. Pair of leads to be used in parallel separated by insulation of abnormally low insulation value but mechanically strong.

1,088,914. INCANDESCENT-LAMP SOCKET; H. Marks and S. Helsel, Johnstown, Pa. App. filed March 13, 1913. Has lock for the lamp.

1,088,923. ELECTRICAL SOUND TRANSMITTER; M. E. Pearson, Seattle, Wash. App. filed March 31, 1913. Embodies two diaphragms.

1,088,963. ELECTRIC CONDUIT; N. W. Buch, New Castle, Pa. App. filed Jan. 29, 1912. Metal pipe interiorly coated with oil paint and then with flexible enamel.

1,088,997. CONNECTOR PLUG; G. C. Knauff, Chicago, Ill. App. filed May 26, 1913. For automobile lamp sockets.

1,089,045. CIRCUIT-BREAKER; C. E. Carpenter and A. J. Horton, New York, and White Plains, N. Y. App. filed May 20, 1907. Overload switch construction.

1,089,048. RAILWAY CROSS-TIE; C. W. Giles, Attleboro, Mass. App. filed Feb. 24, 1913. Metallic tie on which rails are insulated; spreading of rails closes signal circuit.

1,089,051. SWITCH MECHANISM; W. Herskovitz, Chicago, Ill. App. filed Jan. 9, 1913. Pull socket; pull on chain throws pawl against ratchet.

1,089,077. ELECTRICAL MACHINE; W. A. Price, Teddington, England. App. filed Jan. 31, 1911. Conversion of direct current into alternating current, employing commutator and electrolytic condenser.

1,089,081. ELECTRIC-CURRENT CONTROLLER; P. J. Ray, Lakewood, Ohio. App. filed May 21, 1913. Compressible resistance with means holding the members thereof under slight pressure to prevent separation and formation of air gaps.

1,089,091. RECEIVING DEVICE FOR WIRELESS SYSTEMS; W. E. D. Stokes, Jr., New York, N. Y., and G. W. Davis, Hoboken, N. J. App. filed Dec. 9, 1908. Stand carrying plurality of responsive elements composed of iron pyrites having carbonaceous shale embedded therein.

1,089,137. BRUSH-LIFTING DEVICE FOR DYNAMO-ELECTRIC MACHINES; G. H. Krauskopf, Pittsburgh, Pa. App. filed June 21, 1912. Pawl engages ratchet to raise the brush.

1,089,142. BRUSH-LIFTING DEVICE FOR DYNAMO-ELECTRIC MACHINES; E. Mattman, Wilkinsburg, Pa. App. filed June 21, 1912. Embodies a resiliently mounted pawl engaging a ratchet on the brush.

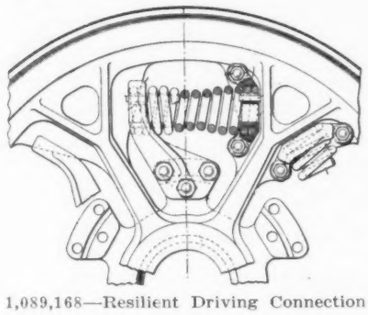
1,089,167. STARTER SWITCH FOR DUAL IGNITION SYSTEMS; G. W. Wacker, East Orange, N. J. App. filed Dec. 20, 1912. "Kick switch" construction.

1,089,168. RESILIENT DRIVING CONNECTION; J. E. Webster, Pittsburgh, Pa. App. filed July 24, 1911. Large-ended coil springs interposed between propelling motor and driving wheels of electric locomotives.

1,089,197. STREET AND STATION INDICATOR FOR CARS; A. Fernandez, Mobile, Ala. App. filed Oct. 20, 1913. Automatically indicates names of cross streets being approached.

1,089,202. RAIL BOND; T. C. Folsom, Tampa, Fla. App. filed Sept. 9, 1912. Mass of fusible conducting material secures the terminal in place.

1,089,277. BED COOLER OR HEATER; G. F. Shepard, Dodge City, Kan. App. filed Nov. 18, 1913. Receptacle of human length which can be made either a heater or a cooler.



1,089,168—Resilient Driving Connection

1,089,300. ELECTRIC FURNACE; C. C. Whitmore, Butte, Mont. App. filed April 16, 1913. Has longitudinal electrodes, one of which may be lowered and raised in respect to the other electrode.

1,089,335. HOLE CLOSURE; D. J. Diel, Jersey City, N. J. App. filed March 29, 1913. For closing conduit openings in outlet boxes, etc.

1,089,336. INDICATOR FOR MEASURING OR WEIGHING MACHINES AND DEVICES; T. W. Fitzgerald, Boston, Mass. App. filed May 31, 1912. Rotary spindle of the primary indicating mechanism is restored to its starting point without influencing or disturbing the secondary indicating mechanism.

1,089,343. SOCKET STRUCTURE FOR ELECTRIC INCANDESCENT LAMPS; J. P. Naylor, London, Eng. App. filed Jan. 10, 1914. When one lamp is removed from the sign or like structure, contacts spring together to maintain the circuit complete.

1,089,384. ELECTRIC BRAKING WITH ALTERNATING-CURRENT MOTORS; E. F. Alexanderson, Schenectady, N. Y. App. filed Oct. 19, 1911. Employs a special design of transformer for connecting the armature and exciting windings in series so as to avoid low-frequency pulsations.

13,693 (reissue). AUTOMATIC BLOCK SIGNALING SYSTEM; D. J. McCarthy, Wilkinsburg, Pa. (Original patent 867,563). App. filed Oct. 1, 1907. Control of distant signals effected by reversing polarity of the track circuit by a pole charger operated by the home signal.